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MOTORSHIP

Devoted to Commercial and Naval Motor Craft

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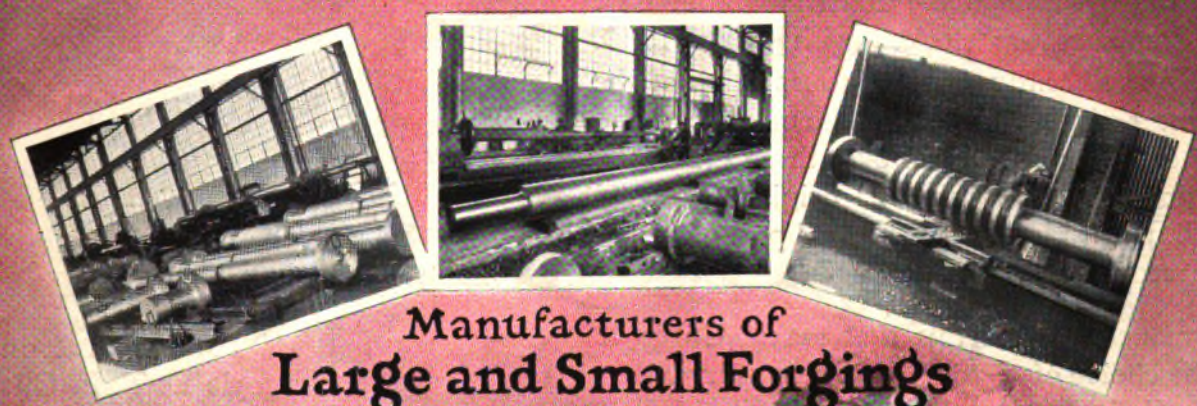
CAMDEN FORGE CO.



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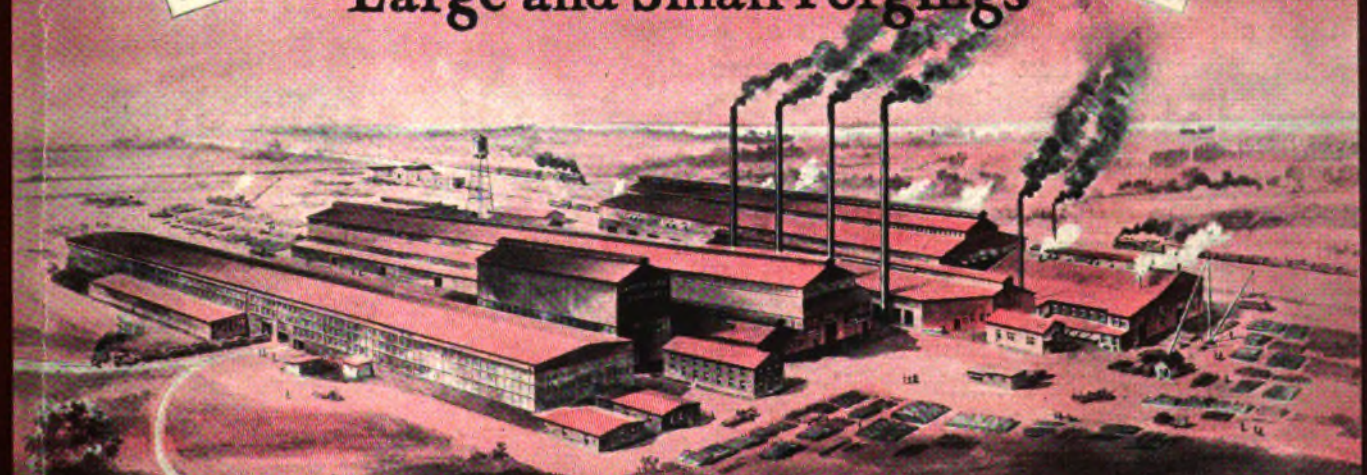

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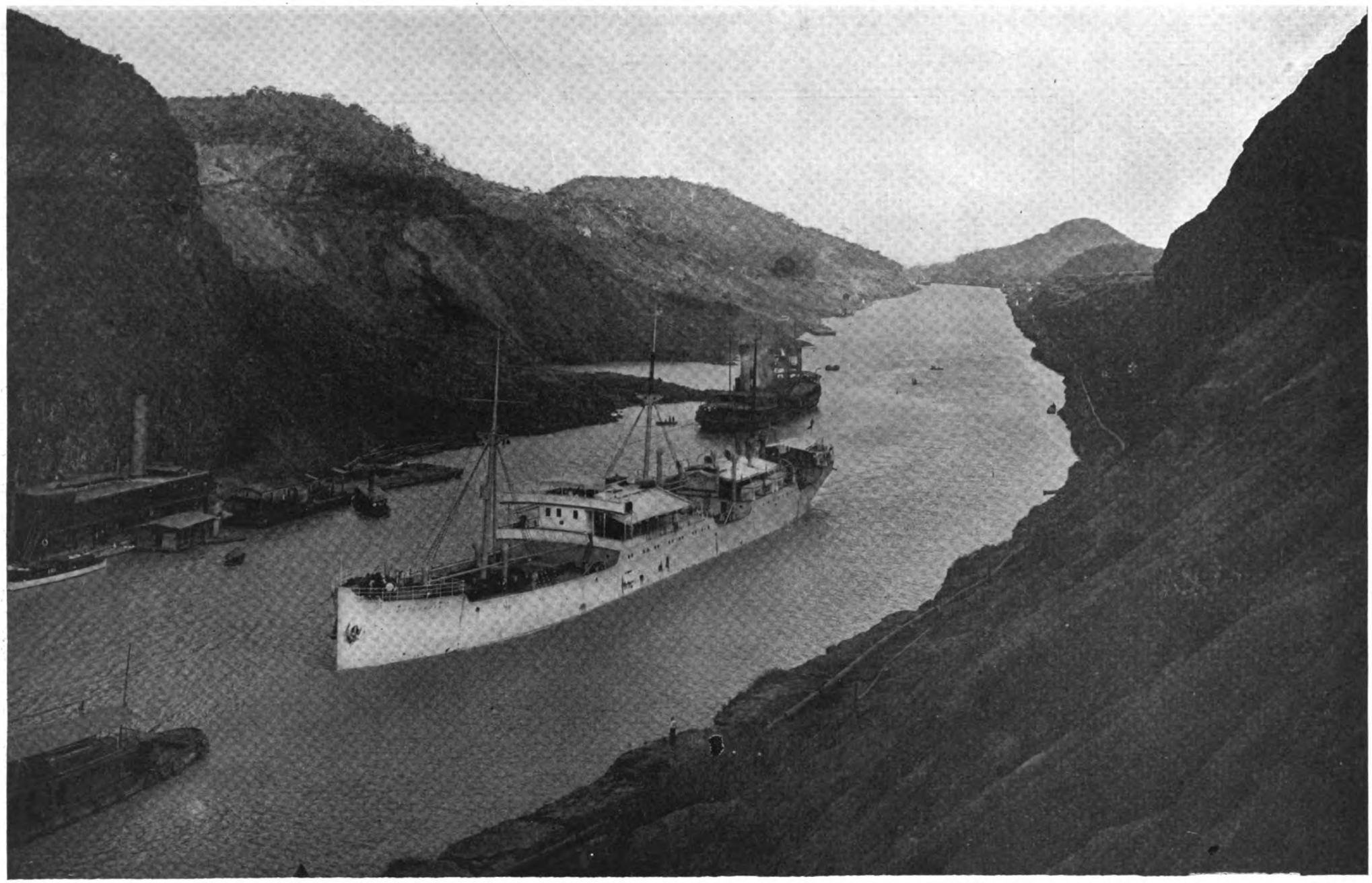

MODERN ECONOMICAL MERCHANT SHIPS—No. 37

The British-built, Danish-owned motorship "JUTLANDIA" in the Culebra Cut of the Panama Canal. She was built early in 1912 for the East Asia Co. of Copenhagen, who already have 12 motorships in service and 17 more on order from 10,000 tons to 13,000 tons d.w. each, and are planning 16,000-ton vessels of 8,000 h.p. and 15 knots speed. Her length is 370 ft. B.P. by 53 ft. breadth and 30 ft. moulded-depth, and has a d.w.c. of 7,570 tons on a 24 ft. 3¼-in. draught, the metacentric height then being 2.08 ft., and does not change when the d.w.c. is 6,980 tons on a 23 ft. draught. On a 14 ft. draught she can carry 3,000 tons of cargo, which is useful in the shallow harbors in the Orient. Her engines are two Barclay Curle built eight-cylinder Burmeister & Wain type Diesels of 1,250 I.H.P. at 125 R.P.M., and her daily fuel-consumption is 8 tons (of Borneo residual-oil of 0.94 specific-gravity) when averaging 10½ to 11 knots. Propellers 11.5 ft. dia. by 9.75 ft. pitch. She has been in service for just over EIGHT years, yet to-day America has no similar vessel!

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MOTORSHIP

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The oil-engined motorship has arrived! It is such a pronounced economy that it was bound to come. Nothing could stop it! And all obstacles have been removed as fast as they arose. The law of progress has seen to that. Very strong prejudices stood in the way of steam. But, one after another they were swept aside and steam reigned triumphant for a century. Steam now has had its day! Its zenith has passed, and gradually but surely it is being superseded by the economical internal-combustion power. Steamships are becoming decadent. America, the most important oil-producing country, is to be the greatest motorship-owning nation. Let us all co-operate and assist to make that day soon.

March, 1920 Vol. 5 No. 3

EDITORIAL

WHO IS RESPONSIBLE?

IN its February issue, our contemporary, "Marine Review," raises an issue on a matter that needs quite a little explanation, as undoubtedly the Diesel Engine Unit of the U. S. Emergency Fleet Corporation has been hampered instead of being sincerely encouraged in its movements. The matter is more than one of indifference, and appears to be one of deliberate blockade. Somewhere in the Shipping Board or Fleet Corporation there exists an element strongly opposing the use of the economical Diesel-engine power in America's merchant ships, even to the extent of setting back the installation of two high-powered engines—purchased a year ago—from "hull 8" to "hull 17" at a well-known shipyard, so that this motorship may not be placed in service and her advantages revealed for about another year, or until after all hope of the Shipping Board building a fleet of motorships has passed. Many propelling Diesel-engines of moderate power have been completed and are building, but as yet not a single engine-room auxiliary Diesel-engine or electric-generator has been ordered, so if these sets are placed in ships, there must be an unwarranted delay while the auxiliary machinery is being constructed. If these matters are investigated perhaps the responsibility for this scandal—as it is a scandal—can be definitely placed.

Various officials of the Board & Fleet Corporation have become firm believers in the merchant motorship, but just as their interest caused them to make deeper investigations, which turned their belief into strong support and even enthusiasm individually, they resigned one after another. Denman, Goethals, Hurley, Mathiesus, Letherbee, Rosetter, Ackerson, Verhey, and so on. So we need look elsewhere for the opposing force. The Diesel-engine and the motorship have not had a square deal from the Government's ship department, with the result that Europe has left us astern in the production of economical ocean cargo-carriers, which must prove a serious detriment to the successful operation of our mercantile marine. There should be an investigation to ascertain who is responsible!

Where America Lags

"THE reason for the indifference of the United States Shipping Board toward the construction of motorships fitted with high-economy, internal-combustion engines of the Diesel type has never been satisfactorily explained. The board, however, must assume a large share of the responsibility for American backwardness in this direction. In the meantime, Europe is forging ahead fast in this new field of marine engineering."

—"MARINE REVIEW," *of Cleveland, Feb.* 1920.

IT'S AN ILL WIND THAT BLOWS NOBODY ANY GOOD

THOUSANDS of fishing-craft, coastwise motor-vessel and motor work-boat owners on the Pacific Coast, as well as dozens of engine-builders, have not yet recovered from the shock of the recent announcement that the Standard Oil Company has permanently withdrawn the fuel known as "distillate" from the market, and that other oil companies are practically certain to follow their example. For years distillate, which is a fuel half-way between gasolene and kerosene, has been very cheap on the Pacific Coast, consequently engines using this fuel have been very popular in

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commercial-craft circles—particularly with boats from 10 h.p. to 500 h.p., and, generally speaking, engine-builders and owners have not bothered themselves with engines of the type that burn much heavier oils. Several companies, however, foresaw that the greatly increased consumption of gasolene would mean that either distillate would greatly increase in price or else it no longer would be obtainable, and adopted heavy-oil engines accordingly.

So great has the demand for gasolene become that we doubt if the oil companies can be induced to change their policy, as the distillate is required for obtaining the lighter and higher priced fuel. Probably many existing engines will be fitted with kerosene-vaporizers as at least a temporary measure; but we have little doubt that the situation will produce a tremendous demand for crude-oil engines, as the average kerosene-vaporizer while sometimes most satisfactory, generally speaking is more or less of a compromise. Unless it is of the gasifying type—by which we mean where the oil is gasified before it is mixed with a sufficient quantity of air to make it an explosive mixture and where cold air can be used for this purpose after gasification—trouble from condensation is sure to occasionally develop. Therefore, if vaporizers are used they should be developed to meet this condition, which can only be accomplished by first mixing a small measured quantity of atmosphere with the kerosene and gasifying the same in an exhaust, electrical, torch, or otherwise heated retort. Once the fuel is "gasified" no known process can return this gas to a liquid, so cold air can be mixed with it without fear of condensation, and with the addition of cold or warm air the gas becomes an explosive mixture. In its first gasified state there is insufficient air mixed with it to form an explosive mixture.

However, to-day kerosene is far from being cheap, so while numbers of existing work-boat engines may be fitted with vaporizers or gasifiers, most owners will replace the machinery with heavy-oil engines. For new craft, there is not much doubt that oil-engines will be installed in the majority. Owners need not fear that there will be a shortage of crude or heavy residual oils, as with the new processes of cracking and distillation now being adopted by the oil companies to secure additional gasolene there will be a large quantity of a low grade of residual oil for which no general market yet has been found. This fuel, we understand, is not very suitable for firing boilers, but will form satisfactory fuel for Diesel-engines. We may have more to say about this oil at a later date.

DO YOU KNOW THAT—

—In Gt. Britain and Continental Europe over 150 merchant motorships, each of between 6,000 and 20,000 tons loaded-displacement, are under construction or on order. Meanwhile many American shipowners and shipbuilders significantly shrug their shoulders, smile and look wise, while others proceed with ordering and building *steam*ships with calm indifference to the immediate future and to what more experienced European shipowners are doing.

During the last six months orders for over half a million tons of uneconomical oil-fired steamships have been placed with American shipyards, while from Europe news of additional motorships being ordered arrives weekly. Let us hope that this astounding situation will be realized in American shipping circles before our shipowners lose their war-made fortunes and their steamers are scrapped as junk. The matter is not one for exaggeration, but is of very serious moment. Many shipowners are not even bothering to investigate the motorship question, as is evinced by their recent recommendations to the U. S. Senate Committee on Commerce, motorships as a solution of our problems only being mentioned in one instance. If they took the trouble to personally visit motorships the situation would rapidly change. The American Hawaiian Steamship Company's splendid example could be copied with beneficial results.

GERMANY'S NEW MERCHANT MARINE TO BE DIESEL-DRIVEN

PERHAPS few things will awaken American shipowners and shipbuilders to the realization of the importance of the oil-engine for cargo ship-propulsion when we mention that Herr Hugo Stinnes has associated himself with the German syndicate that already has closely investigated the question of basing the reconstruction of Germany's merchant-marine upon the use of oil-engines.

In announcing this fact, Vice-Admiral Hullveg attaches particular importance to the derivation of fuel-oil from coal, which oil has been used for Diesel engines with success for many years in Europe. He considers that there is an excellent economic case for the motorship and that Germany can compete in technique with any other nation. Also that the extraction of tar-oil from coal will yield sufficient liquid-fuel for the needs of the mercantile-marine and at the same time make use of the greatest thermal-value of coal.

Furthermore, at the recent special meeting of the Hamburg-American Line, Herr D. V. Schienkel stated that the policy of the company would be to participate in the handling of such undertakings as that of fuel-oil. "MOTORSHIP" has already announced that the A.E.G. and the Hamburg-American Line have secured a Burmeister & Wain Diesel marine-engine license, and will build these motors for their merchant-ships. They also have a Junkers-engine license.

American-Hawaiian S. S. Co. Leads the Way!

Two 11,000-Ton Motorships Ordered—Diesel-Set of 4,500 i.h.p. To Propel Each Vessel

THROUGH the courtesy of the American-Hawaiian Steamship Company, of New York, we are enabled to make the first official announcement regarding the results of their investigations into the motorship question. They have placed an order with the Merchants Shipbuilding Co. for two steel Diesel-driven freighters of 11,200 tons d.w.c. each, and the engines will be built by the Wm. Cramp & Sons Ship & Engine Co. under license from Burmeister & Wain, of Copenhagen. Thus they have set a splendid lead that other shipowners needs must soon follow.

We tender our congratulations to this well-known steamship company for being the first American firm to place an order for a pair of such big Diesel-driven freighters, and the fact that they have no financial interest in, or relations with, any Diesel-engine builder adds to the importance of this order, as it demonstrates that the motorships have been ordered solely on their merits as ocean cargo-carriers of the most economical type, the order having only been placed after a most exhaustive study and consideration. It is the start of a new era in the annals of American shipping.

The two new ships will have the following dimensions:

Length O. A.	461 ft. 10 in.
Length B. P.	445 ft.
Breadth	60 ft.
Depth to shelter deck	39 ft.
Depth to upper deck	32 ft. 6 in.
Underdeck cargo capacity (bales)	550,300 cu. ft.
Dead-weight capacity	11,200 tons
Bunker capacity (oil)	1,200 tons
Speed (loaded)	11½ knots
Horsepower	4500 i.h.p.
Horsepower (steam equivalent)	4000 i.h.p.
Daily fuel consumption	15 tons
Cruising radius	21,500 miles, or 78 days
Auxiliaries (Diesel-electric)	Three 150 b.h.p. engines

This cheerful news comes just as we close for press with this issue, and almost simultaneously with the announcement that the British and Mexican holdings in this important steamship company have been secured by American financiers and that it is now 100 per cent. American. In our next issue we anticipate publishing plans and complete details of these motorships.

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Remarks and Suggestions for Placing the American Merchant Marine on a Permanent Basis and to Enable Our Cargo Ships to Operate With Profit Against Those of Other Nations

Prepared Specially for the U. S. Senate Committee on Commerce by Request

By Thos. Orchard Lisle, Editor of "Motorship," New York, N. Y., and Seattle, Wash.

The most vital and important factor of all is that our freight and oil-carrying ships shall be the most economical type obtainable to-day. They must be able to carry the largest quantity of bulk or dead-weight cargo possible on given dimensions and amount of structural steel at the highest practical speed on the lowest consumption of fuel.

Sirs:

Because of the enormous volume of money furnished by Congress it was a comparatively simple matter to place a large merchant fleet on the Seven Seas, but with a discontinuance of Government money to back the operation of these ships, the question of running them at a profit in the face of steadily increasing competition from the rest of the maritime world is quite a serious one.

Nevertheless, it is obvious that very shortly the Government must turn-over all the shipping and shipbuilding to private capital, and shipowning companies must operate these ships without Federal subsidies; otherwise, our mercantile marine will be founded on a false basis, and will not be substantial or permanent in itself.

In several ways the existing shipping laws need revision, but there are other matters of greater importance to the future success of our ships that first need attention. It is with these things I propose to deal, leaving the questions of crews, laws, docks, overseas freight-agents, taxation, registration, etc., to be dealt with by others who have made a special study of those subjects.

The most vital and important factor of all is that our freight and oil-carrying ships —which are of greater moment to our trade and commerce than are passenger liners— shall be of the most economical type obtainable to-day. They must be able to carry the largest quantity of bulk or dead-weight cargo possible on given dimensions and amount of structural steel at the highest practical speed on the lowest consumption of fuel.

Unless our merchant-ships fully meet these requirements no laws, subsidies, or any form of Federal or private operation can permanently keep our ships on the high-seas of the world in the face of the severe competition that soon will be centered against them by shipping interests of other countries. And, one after another the different overseas trade-routes will be abandoned by our shipowners and their ships will be laid-up to rust in harbors or sold to other countries.

The question is, do our existing ships and those now completing meet this factor— that is—are they of the most economical type?

The answer is in the negative. Most of them were vessels designed and laid-down to meet an emergency of war and are utterly unsuitable and inadequate to meet the competition of certain types of ships now in service of Europeans and building in Europe and in the Orient.

To-day the most economical type of ship practical up to 20,000 tons loaded-displacement is the Diesel internal-combustion oil-engined motorship, and it is to this class of carrier that America must turn if its fleet is to stay on the seas. The greater part of existing fleet must be converted to Diesel power in batches of 10 or 20 as speedily as feasible. Meanwhile it should be balanced by the immediate construction of 50 to 100 Diesel-driven freighters and tankers of 10,000 and 12,500 tons d.w.c. and of 14 knots (minimum) loaded-speed.

These vessels should be constructed by the Government, and chartered or sold to private shipowners and run on the same routes as their steamships in order that the advantages of the wonderful economies can be realized and in order that their crews shall become familiar with their operation.

The Government must not vacate shipbuilding and ship-operating until it has demonstrated to private interests and capital—most of whom are infants in the shipping business—in a practical and indisputable manner that ships can be built which can hold their own in competition against the vessels of other nations.

At the present moment the Diesel Engine Department of the U. S. Emergency Fleet Corporation (Hubert Verhey, chief of the department, who should be called before the Committee on Commerce to give evidence) has what is probably the most valuable collection of Diesel-engine and motorship technical and operating information in the world. This should be made available to shipowners by incorporating the same in a fleet of modern motorships.

A motorship of the same dimensions of a steamer can carry 10 to 12% more cargo each one-way long-distance voyage because of the saving in bunker-space, due to the fuel-consumption being 75% less than an oil-fired reciprocating or geared-turbine steamer, also because of the machinery weighs less and occupies less space, and because no boiler-water has to be carried.

On a short voyage, say—New York, N. Y.-Gothenburg, Sweden—the motorship can discharge 400 to 500 tons of its 1,000 tons of bunker-oil, sell it as high-priced cargo and still have sufficient fuel to return to the U. S. A. This, in addition to carrying 500 to 600 tons more general cargo than a steamer. I refer to vessels of 10,000 tons d.w.c. The following is a comparison between an oil-fired steamer and a Diesel-driven motorship of the same dimensions (taken from an existing motor vessel):—

(For table see following page)

[Since the above was written Mr. Verhey has resigned.—Editor.]

It will be noticed that while the first cost of the motorship is 10% higher than the steamer, the cost of the motorship per ton of **actual** carrying-capacity-ton is slightly less than that of the steamer. This because the motorship carries a greater quantity of cargo and a smaller amount of fuel Yet on this reduced bunker the motorship can sail **over** double the distance without re-fueling.

In its report for 1919 the U. S. Shipping Board on pages 116-117 stated:—

> "As the Diesel-type of internal-combustion engine has demonstrated its practicability and reliability as well as an economic advantage of the highest order, it was thought advisable to make use of this type of engine in connection with the new vessels. In order to make an intelligent comparison, however, it was concluded that some of the vessels of the 10,000 dead-weight-tons type, identical in every other respect, be fitted with quadruple-expansion engines and Scotch boilers, and the others with the Diesel-type internal-combustion engine."

But, the Shipping Board has only **one** motorship on order. It also has built or on order 36 Diesel-engines of about 1,100 i.h.p., each suitable for ships of about 5,500 tons d.w.c., but no hulls have been or are being provided for these engines.

Therefore, it is not surprising that in his report for 1919 Secretary of the Interior Franklin K. Lane said:—

> "We have ventured on a great shipbuilding program; on private ways and on Government ways ships are being built to go around the world—ships that are to burn oil under boilers and produce steam * * * I submit that there should be justification shown for the construction of any oil-burning ship which does not use an engine of the Diesel type. * * *
> This Government might itself well undertake to develop an engine of this type for use on its ships. We simply cannot afford to preach economy in oil when we do not promote by every means the use of the internal-combustion engine for its consumption. No other one thing that can be done by the Government, our industries, or the people, will save us as much oil from being wasted and thereby multiply the real production of the United States. A nation that can educate 10,000 automobile mechanics in 60 days might indeed develop 1,000 Diesel engineers in a year. The matter is of too great moment for delay. It touches the interest of everyone."

One other reason why America must have motorships is because the fuel-consumption economy of the Diesel engine enables very much higher ship-speeds to be obtained than are practical with oil-fired steamers.

In fact, a 16-knot motor freighter would consume 3 tons per day less fuel than a 11-knot oil-fired steamer, or 10¾ tons less fuel per day than a 11-knot coal-burner of the same size.

Therefore, Diesel engines will enable our

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Comparison Between an Oil-fired Steamer and a Diesel-driven Motorship of the Same Dimensions.*

(Taken from an Existing Motor-Vessel)

	STEAMER	MOTORSHIP
Length O. A.	440 ft.	440 ft.
Length B. P.	425 ft.	425 ft.
Breadth	56 ft.	56 ft.
Depth	38 ft.	38 ft.
Draught (Loaded)	26 ft.	26 ft.
Dead-weight-capacity	9,350 tons	9,500 tons
Fuel-Capacity	1,300 tons	1,300 tons
Cargo-Capacity (Maximum on 7,600 Miles Voyage)	7,970 tons	8,925 tons
Designed Loaded-Speed	13¼ Knots	13 Knots
Probable Average Sea-Speed for 1 year:	11½ to 12 Knots	12 to 12½ Knots
Power	4,000 I.H.P.	4,000 I.H.P.
Propeller Speed	85 R.P.M.	100 R.P.M.
Reserve Emergency Power	15%	30%
Cruising Radius (in days)	33	100
Cruising Radius (in miles)	10,296	31,200
Daily Fuel-Consumption (loaded)	38 tons	12½ tons
Consumption per I.H.P. hour	0.95 lb.	0.30 lb.
Lubricating-Oil consumption per day	7 gallons	12 gallons
Fresh-Water Carried (including for Boilers)	150 tons	50 tons
Daily Fuel-Consumption in Port	3½ tons	1¼ tons
Engine-room Staff	23 men	17 men
*Annual Wages (Machinery-Staff Only)	$22.500	$20,820
Total Ship's crew	49 Men and Officers	43 Men and Officers
First Cost of Ship	$1.400.000.00	$1,540,000.00
First Cost of Shipper Cargo-Capacity-ton	$175.65	$172.54
First Cost of Ship per D.W.C. Ton	$150.00	$161.68

*American scale *The loaded displacement of both ships is the same.

ships to make quicker port-to-port passages than the steamers of foreign nations, and so increase the annual earning power. Furthermore, the extra speed may often enable a ship to get a discharging berth ahead of a dozen slower foreign ships that might have sailed for the same destination several days before, and which otherwise would have been entitled to priority in discharging their cargoes.

To make this speed question clear I append a comparison table:

Fuel-Costs Per 10 Days Voyage of 16-knot Ships.

(**Coal** $6.50 per ton. **Crude-oil** $10.50 per ton. **Diesel fuel-oil** $15.00 per ton.)

Diesel Motorship	$ 4,350.00
Turbine Oil-fired Vessel	10,082.60
Reciprocating Coal-burner	9,720.00

The big distinction between the price of the fuel-oils per ton is not necessary, but as the motorships would be experimental it would be advisable to use a fair quality of residual oil-fuel such as Solar-Oil instead of a heavy and dirty crude-oil.

CARGO VESSELS OF ABOUT 14,000 TONS LOADED DISPLACEMENT
(With Average Block Co-efficient)

Loaded Speeds*	11 knots	12 knots	14 knots	16 knots
Indicated horse-power	3,000	4,000	6,500	9,000
Daily Fuel-Consumtpion				
Diesel motorship	9¼ tons	12¾ tons	20¾ tons	29 tons
Turbine oil-fired vessel	32 tons	42¾ tons	70 tons	96¼ tons
Reciprocating coal-burner	49¾ tons	66¼ tons	107¾ tons	149½ tons

*The speeds refer to what the vessels should average over about year's period including heavy winter weather.

Because of the above I propose that the fleet of 50 to 100 motorships to be built by the U. S. Government shall be of 14 knots loaded speed, or if possible 15 knots.

Also, that **three** experimental 16-knot Diesel-driven express-freighters shall be built. I say "experimental" because they would entail higher-powered oil-engines than yet have been built in the U. S. A. Nevertheless, the Diesel engines of the American built motor tanker "Maumee" have a higher cylinder output than the engines of any European Diesel engine in service. Each of her two motors normally develop 2,500 shaft H.P. (3,400 i.h.p.) in six cylinders, and have developed as high as 3,050 i.h.p. (8,000 i.h.p. in aggregate) or 660 i.h.p. per cylinder. This vessel has cruised 100,000 nautical miles fueling the U. S. Fleet. [Also Diesel engines of greater output than any European marine sets are now under construction to the builder's own order in an American plant, and without any shipowner's moral or financial assistance.—*Editor.*]

The importance of 16-knot cargo-ships can be gained from the following fuel bill comparison:—

Conversion of Existing Steamships

The question of converting existing steamships as advised above will involve a great deal of study and calculations and many factors will have to be weighed. It is obvious that ships cannot be drawn wholesale from the trades and laid-up for structural machinery alterations while the present demand for bottoms exists.

But, the majority of vessels have to be dry-docked for repairs and alterations, painting, scraping, overhauling, etc., once a year or once in two years, so that around the various harbors and dry docks are always to be found vessels idle, or waiting for admission to the dry docks. Opportunities should be seized to convert such craft and the work of conversion should not take longer than six weeks to two months, provided the engines are ordered and completed in advance.

When I was in Sweden, the Superintending-Engineer of the ———— Steampship Company and informed me that the directors of his company were very seriously considering converting their large steamship fleet to Diesel power, in addition to ordering new motorships. This, because the operation of the motorships which they had in service convinced them of the wonderful economy and reliability.

He showed me the plans of the steamship ———— as she now is and as she will look when converted. This will be the first ship they will convert. She is a vessel of about 7,000 tons loaded displacement and of 5,300 tons d.w.c. Including bunkers, the cubic capacity of this ship is 252,704 cu. ft. When converted to Diesel-power a gain of 13 frames space (or 26 ft.) will be made and the absence of the smoke-stack will enable the bridge to be moved further aft and an extra cargo-hatch installed, the latter increasing the loading and unloading speed.

Furthermore, there will be a gain of 36,000 cubic ft. of cargo space, plus 250 tons of 'tween-deck bunker space. This means a total gain of approximately 48,000 cubic ft. The exact gain of cargo, of course, depends upon whether light-bulk or heavy-bulk is being shipped.

The present fuel-consumption is 22 tons per day at sea, and 4 tons per day at port. This will be reduced to 6½ tons per day at sea, and ¾ of a ton at port per day. The bunker capacity will be reduced from 800 tons to 300 tons, but her cruising-radius will be increased.

The new engines will be of a little higher power, so that the new speed will be 11 knots compared with the previous speed of 9 knots.

A Diesel engine of 2,000 i.h.p. at 80 R.P.M. will be installed in place of the present propelling machinery and all the steam-piping and steam-winches on deck will be removed and replaced with electrical-winches and and electrical-heaters, so that the ship will have no steam whatever.

Several years ago the East Asiatic Company decided to convert three of their steamships, namely, the "Bandon," "Pangon" and "Chumpon," to Diesel-power. This was done, with the result that these three ships now together carry 2,400 tons more cargo per one-way voyage than they previously could handle, and their fuel bills have been reduced to ¼ of the previous amount.

These vessels are of 6,000 tons carrying-capacity and their reciprocating steam-engines and boilers were removed and replaced by a 6-cylinder 1,700 i.h.p. at 110 R.P.M. Diesel engine. Each vessel now carries 600 tons additional cargo per one-way voyage in addition to 600 tons of bunker oil—the latter being sufficient for a voyage of a little over 16,000 nautical miles.

The original engine and boiler crew consisted of 14 men, but the ships now only carry 5 engineers and 3 greasers, or a staff of 6 men, no firemen being needed. The previous fuel-consumption of each of these ships was 28 tons per 24 hour day. This now is 8 tons per day, of which the main Diesel-engine uses 5¾ tons; the auxiliary donkey-boiler 2 tons; and the auxiliary Diesel engine ¼ ton. If the donkey-boiler and steam-winches were replaced by Diesel-electric mechanism, a saving of another 1½ tons of fuel per day could be effected.

The three vessels mentioned above were recently purchased by the Norwegian Government and renamed the "Landvard," "Lidvard" and "Folkvard."

I estimate that if 200 American oil-fired or coal-fired steamers of 10,000 tons d.w.c. each were converted to Diesel power, the additional cargo capacity in aggregate would be 200,000 tons per one-way voyage, allowing 6 round voyages per annum, it would mean that **these 200 ships would have**

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an additional carrying-capacity of 2,400,000 tons annually.

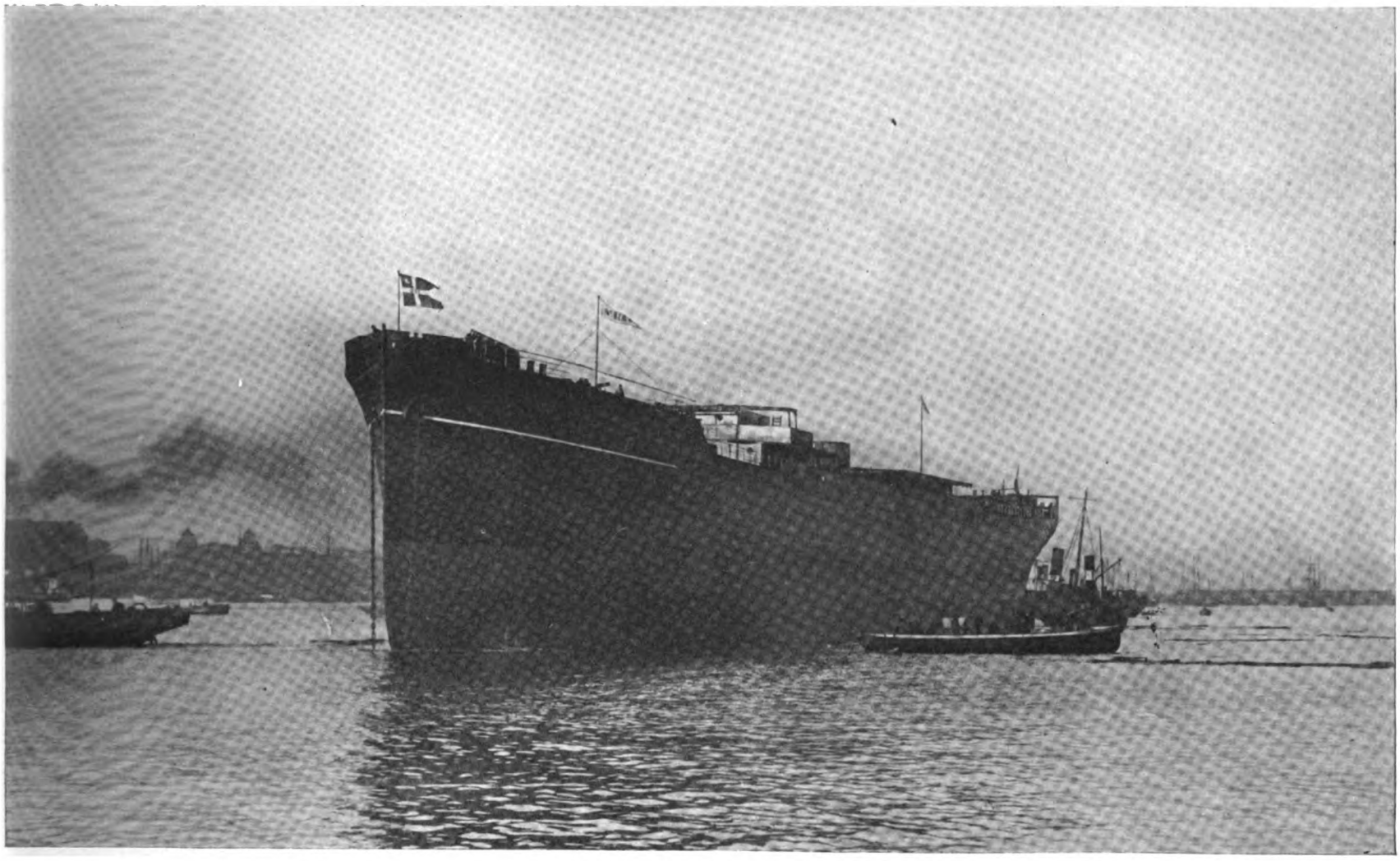
If they were 13-knot ships, the **daily** fuel-consumption of **each** ship would be reduced from 38 tons of oil to 12½ tons of oil. Over a period of one year this would mean an enormous saving in valuable fuel-oil (5,300 tons each day the ships were at sea).

It is rather interesting to record at this time that Mr. William Denman, Ex-Chairman of the Shipping Board, recently stated that under his chairmanship the Board planned to build 24 Diesel-driven motorships of 9,588 tons capacity. These were to be built by a group of interests, among whom were the William Cramp Ship & Engine Building Co. of Philadelphia.

The plans of the vessels and engine had secured the approval of Mr. Theo. Ferris, then Naval Architect to the Board, and also Mr. Denman and General Goethals were in substantial accord regarding the construction of these motorships.

Unfortunately, on July 24, 1917, the day set for the final discussion was the day that both General Goethals and Mr. Denman resigned.

Yours respectfully,
(Signed) T. ORCHARD LISLE,
Jan. 9, 1920. Editor of "Motorship."



WHILE AMERICA SLEEPS!

The "AFRIKA." She is the latest motorship of the great East Asiatic Line, and is of 18,600 tons displacement, 4,500 i.h.p. and 12 knots speed. With a cruising radius of 30,000 miles, her loading-capacity is 872,300 cubic feet of grain. Daily fuel-consumption 12 tons. No steamship in the world will be able to compete against her.

Recent Danish Motorship Progress

Launch of the "Afrika," the First of the 18,600 Tons Displacement Diesel-Vessels at the B. & W. Plant, and Launch of the Holeby-Diesel Tanker "Mexico" from the Nakskov Yard. Big Sixteen-Knot Motor "Express Freighters"

By the Editor of "MOTORSHIP"

NOW the war is over and materials for ship and engine construction are easier to obtain in Denmark, the work of launching ocean-going motorships has speeded up, and two more large Diesel-driven vessels—the "Afrika" and the "Mexico"—have lately taken the water, while very shortly the first of the 19,000 tons d.w.c. motorships will be launched at Copenhagen. Also the Burmeister & Wain Co. have been able to commence the needed extension to their 4-berthed shipyard on the island of Refshale, near Copenhagen. For years they have carried out negotiations for expansion on the Sound side of their yard but the Danish army authorities would not permit such work during the war.

Nevertheless, little Denmark has maintained its remarkable progress in motorship building, and is still going strong, both with regard to expanding the power and tonnage range of new types and in respect to the number of Diesel-driven cargo passenger ships and tankers being turned out from the two principal yards.

The two leading factors of this development are naturally still the East Asiatic Co., who order the ships, and Burmeister & Wain who supply the constructional skill, a happy combination that could be copied with advantage in the United States, where shipowners seem reluctant to place the necessary confidence in ship and engine builders. In other words their attitude is virtually a silent testimony—probably intentionally—that they do not believe in the engineering ability of their own shipyards and engineering-works.

Burmeister & Wain hold orders for seventeen big motorships from the East Asiatic Company alone, in addition to orders for motorships from other Scandinavian ship owners such as Fred Olsen, Otto & Thor Thorensen, the Grangeborg Co., etc., and the first of the 13,000 tons d.w.c. (18,600 tons displacement) boats is now afloat and soon will run trials, while—as mentioned—the first of the 19,000 tons d.w.c. (about 25,000 tons displacement) Diesel ships will soon be nearing the launching stage. This latter ship is 485 ft. long, and 6,600 i.h.p. in twin-screws, and the engines will be eight-cylinder sets of the four-cycle type similar to those in the "Glenapp" and sister British motorships. Meanwhile, most American shipowners unfortunately seem to be asleeep at their desks.

If these large motorships are as successful as expected there will be laid-down much bigger Diesel ships of 16-knots and 8,000 horse-power for which plans are now being

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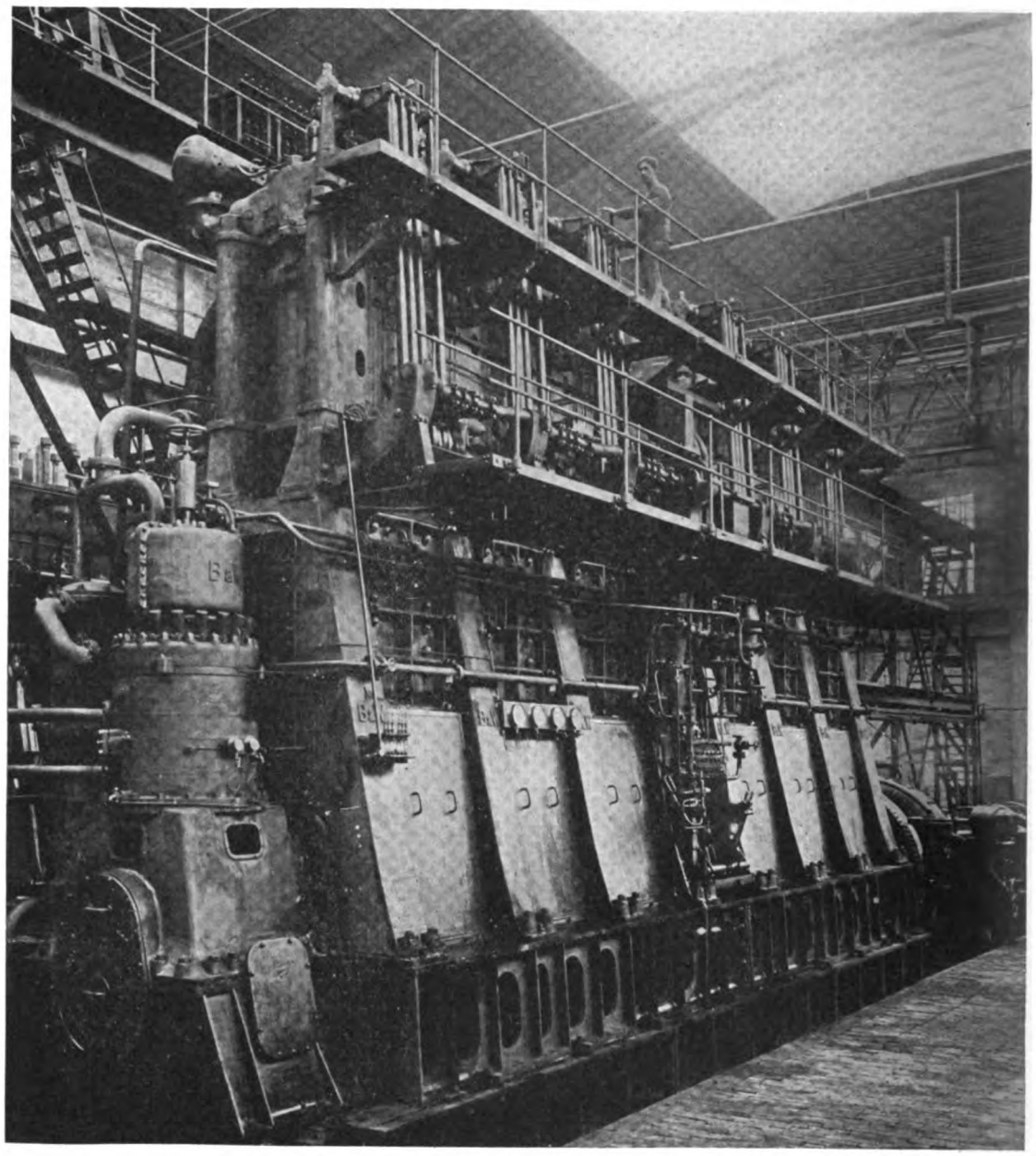
prepared. This means the advent of the "express freighter," which vessels are an economic possibility, as they will not burn 30 tons of crude oil per day—probably around 25 tons.

Another Danish company has entered the motorship field, namely the Orient Steamship Co. of Copenhagen, as referred to in "Motorship" early last year. This is the shipowning concern that purchased the coal-burning steamers of the East Asiatic Co. when that company decided to operate motorships exclusively, of which they already have twelve in service. They, too, have realized the wonderful economic qualities of the Diesel drive, and their first full-powered motorship is in a well-advanced stage of construction at the Nakskov shipyard. She is of 9,000 tons d.w.c. and will be propelled by Burmeister & Wain motors. Another ship for them will be of 13,000 tons d.w.c. and will be a sister ship to the "Afrika," which we illustrated and will presently describe. There there is a craft of 1,000 tons d|w.c. which will have a Holeby-Diesel engine installed.

As mentioned in "Motorship" of April, 1919, the Danish Diesel Motorworks, at whose plants the Holeby and Guldborg engines are built, is now consolidated with Burmeister & Wain, as also are the Nakskov and Helsingors shipyards and the Copenhagen Drydock; while the Orient S. S. Co. and the United Steamship Co. are related to the East Asiatic Co. with whom Lord Pirrie, of Harland & Wolff, is connected, so that the combination of motorship interests is very strong indeed. Counsellor-of-State Andersen is the far-sighted man responsible for this great motorship development.

The United Steamship Co. of Copenhagen (Forenade Dampskibs Salskab Det) own over 100 steamers as well as the two big cargo motorships "California" and "Oregon." Not long ago the American-Hawaiian Steamship Co. of New York chartered the "Oregon" and were enabled to ascertain for themselves the enormous earning-power of these motorships and their reliability. This is one of the factors that has led towards the early ordering of a fleet of motorships by this well-known American firm, who will lead the way so far as the U. S. A. is concerned.



One of the twin 2,250 i.h.p. Burmeister & Wain Diesel-Engines of the East Asiatic Co.'s latest cargo-passenger motorship "AFRIKA." They are similar to the pair purchased a year ago by the U. S. Shipping Board, but not yet installed.

The new Holeby Diesel-engined tanker "Mexico" of the East Asiatic Line.

THE FREIGHTER "AFRIKA"

General dimensions of the motorship "Afrika" are of interest. They are as follows:

Loaded Displacement	18,600 tons
Dead-Weight Capacity	13,250 tons
Gross Tonnage	9,050 tons
Fuel and Lub. Oil Capacity	1,472 tons
Cruising Radius	30,000 nau. miles
Loaded Speed	12 knots
Passenger Accommodation (De-Luxe)	cabins for 10 persons
Loading Capacity	872,300 cu. ft. grain
Loading Capacity	616,700 cu. ft. bales
Water Ballast	1,684 tons
Class Registration	Lloyds 100 A1. awn deck
Length O A	464 ft. 6 in.
Length B. P	445 ft.
Breadth O. F	60 ft.
Depth from Awning Deck	42 ft.
Depth from Upper Deck	33 ft. 3 in.
Depth from Lower Deck	23 ft. 3 in.
Loaded Draught	31 ft. 6 in.
Height of Double-Bottom	3 ft. 10 in.
Main Engine Power	4,500 I.H.P.
No. of screws	Twin
No. cylinders per engine	6
Fuel Consumption per I.H.P. Hour (including auxiliaries at sea)	0.31 lb.
Total Daily Fuel Consumption at Sea	12½ to 13 tons
Cargo Winches	One of 30 tons, one of 15 tons, twelve of 5 tons and eight of 2 tons

It should be noticed that the fuel-capacity of about 1,500 tons is sufficient for 30,000 miles at full-speed, so when making round voyages of 6,000 to 10,000 miles *she will be able to discharge and sell close upon 1,000 tons of her*

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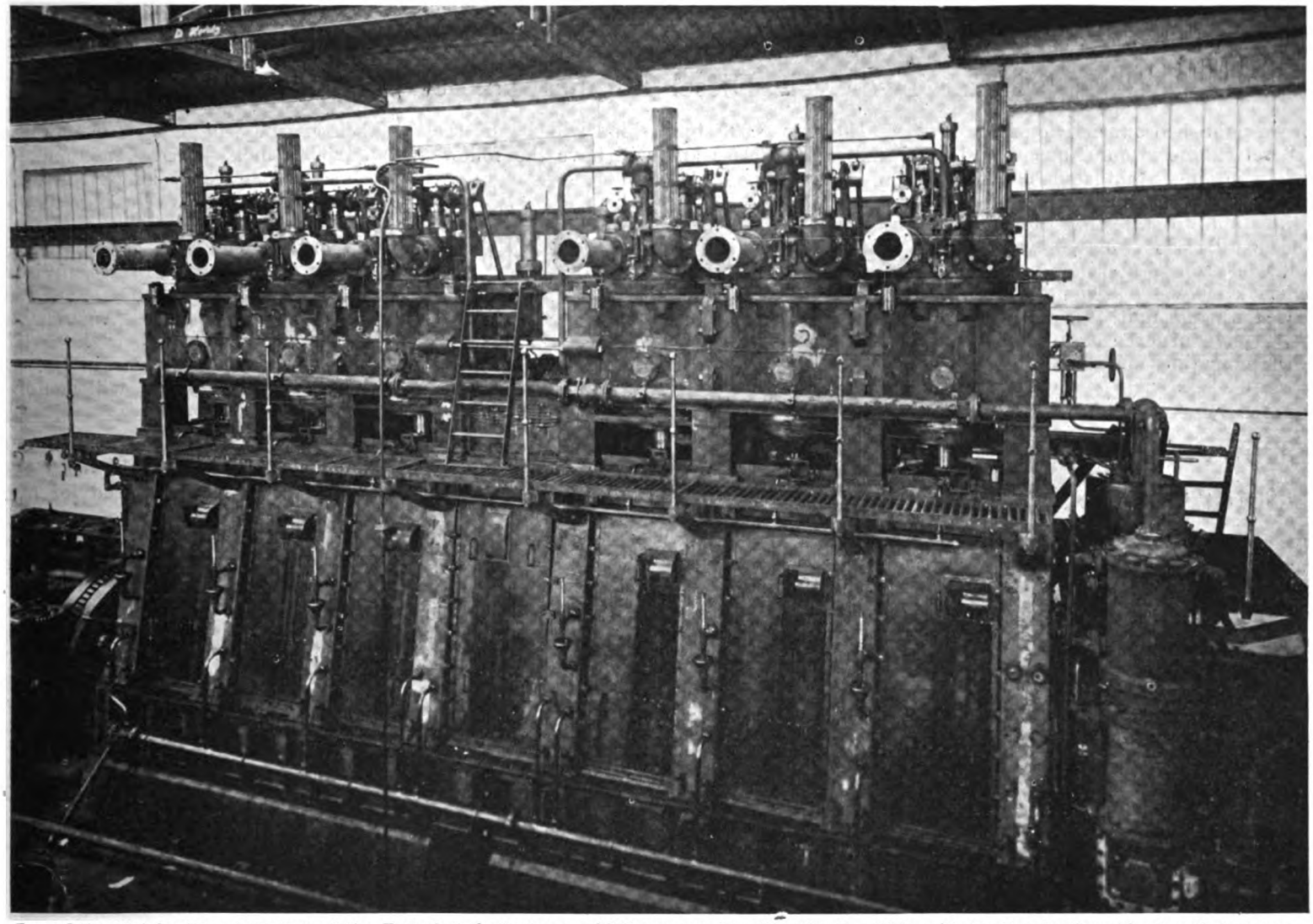


One of the Holeby Diesel-engines of the East Asiatic Co.'s new 4,700 tons tanker "Mexico," which will be the fueling-ship for their great motorship fleet.

bunker oil as cargo, and thus increase her already large freight capacity, as on such a voyage fuel oil is almost bound to be cheap at one end and expensive at the other, so she can take advantage of this situation without interfering with her hold or deck capacity. *This an oil fired steamer of her size and speed could not do; on a 10,000 miles voyage almost all the 1,500 tons of oil would be needed for fuel.*

Thus, the larger the ship, the greater are the advantages of motor power. Also, *this peculiar feature of the motorship disputes the contention that Diesel vessels only show their economy on long voyages* A 1,000 tons of fuel oil discharged from her bunkers in a Scandinavian port to-day would produce nearly 200,000 Kroners (about $57,000 normally, or say $38,000 at present exchange rates). If she made seven round voyages per year from New York to Scandinavia *it would mean an annual revenue of $266,000 to $399,000* (according to the rate of exchange) *to be derived solely from the sale of surplus bunker-oil, without counting the gain in cargo-space due to the absence of boilers, condensers and boiler-water.* How many shipowners have taken this most important advantage into calculation?

As will be noticed from the tabulated details, ample arrangements have been made for rapid handling of the cargo, there being 22 electric winches of 121 tons aggregate lifting capacity, of which one is of 30 tons and another of 15 tons. Power for these winches, the electric capstan, the electric hydraulic steering gear, and other auxiliaries, is furnished from four Diesel-driven 65 k.w. generators in the engine-room, of which one is a stand-by. The electrical mechanism was partly constructed by Burmeister & Wain and partly by the Asea Co. of Vesteras (Swedish General Electric Co.). The wireless and refrigerating plant was made by Thoma Ths. Sabroe & Co., Aarhus, Denmark. The deck machinery has a 220-volt current, but 110 volts is used for the Electric lighting of the ship.

This refrigerating set is of good size, the lower hold immediately forward of the engine-room being insulated and equipped for the transportation of fruit. Two air channels are arranged at each end of the hold, the brine cooling spirals being fitted in the air channels, and the air circulated through radiators and through the channels.

THE TANKER "MEXICO"

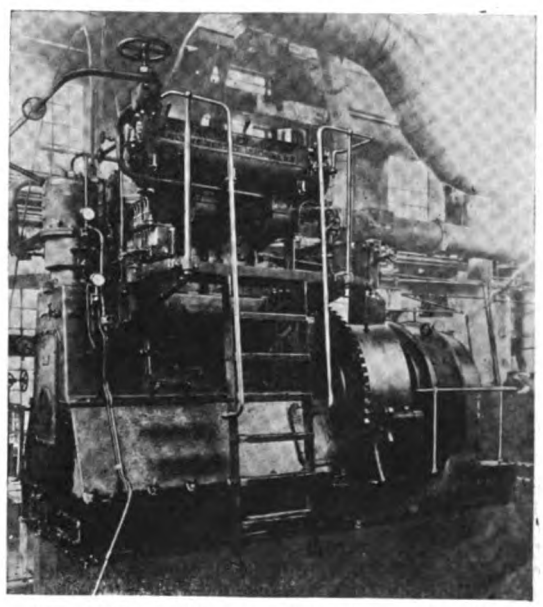
It is not without interest to mention that the East Asiatic Co.'s new tanker "Mexico" has been built at a shipyard erected during the war, namely the Nakskov yard, which was originally laid out for constructing standardized four-masted motor auxiliary schooners of 600 tons d.w.c in steel, or 500-550 tons in wood, and each equipped with a 160 b.h.p. Tuxham surface-ignition two-cycle type oil-engine, or a four-cycle type Holeby Diesel oil-engine. A number of these craft were launched when the yard was owned by Mr. Alfred Christensen, a Danish shipowner, and some of these little vessels are still on order for him as well as for the East Asiatic Co.

Although wooden shipbuilding still continues, the yard has gone ahead under the new management despite the fact that shortage of material has had a hampering effect. But the owners did not let the latter situation hinder the building of the motor tanker "Mexico," as they procured frames and plates from a new, but costly, source; namely, Sweden. As stated the other three steel motorships under way at the Nakskov yard is a 9,000 tonner, and the 13,000 tonner that is a sister to the "Afrika," also a 1,000 ton boat.

In our issue of April, 1919, we described the "Mexico," on page 45, and also gave the plans of her engine-room arrangements. We will repeat her dimensions, as follows:

Dead-Weight Capacity	4,700 tons
Length	300 ft.
Breadth	44 ft.
Depth	38 ft.
Power	1,600 shaft h.p.
Ship's Speed	10½ knots
Engine Speed	140 r.p.m.
No. of Screws	Twin
Total Daily Fuel Consumption	6½ tons
Type of Auxiliary Machinery	Diesel-Electric

The two Holeby-Diesel engines that propel the ship each develop 800 b.h.p. from six cylinders 19¾ in. dia. by 29½ in. stroke at 140 r.p.m., and one of the four-cycle, single-acting, crosshead, direct-reversible class, with oil-cooled pistons. Further details can be obtained by referring to the article previously published in "Motorship."



An auxiliary dynamo set for the motorship "Afrika."

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Three Large Motorships for the Orient Company

Sulzer Two-Cycle Diesel Engines To Be Installed

When we published our article on the new Sulzer-Diesel engine in our November, 1919, issue, we mentioned that four marine oil-engines of 1,250 shaft h.p. had been ordered. We are now able to state that these engines are to be installed in two twin-screw cargo vessels of 8,000 tons d.w.c. now building for the Rederiaktiebolaget Orient, of Stockholm, Sweden, and that the same firm of shipowners have ordered two more Sulzer marine Diesel-engines of 800 shaft h.p. for another ship.

The two 8,000 tons ships will be of the shelter-dack class and will have the following dimensions:

Deadweight capacity	8,000 tons
Length, B. P.	410 ft. 0 inch
Breadth, Mld.	54 ft. 0 inch
Depth	27 ft. 6 inch
Power	2,500 shaft h.p.
Total number of cylinders	8
Engine-speed	90 R.P.M.
Ship Speed (Normal)	12 knots

Each engine will have four-cylinders 600 mm. (23.622 inch) bore by 1060 mm. (41.732 inch) stroke and will be of the two-cycle single-acting type, developing its normal power at 90 R.P.M. The scavenging-air will be supplied from electrically-driven turbo-blowers. Sulzer Frères, Winterthur, Switzerland, will construct the engines. Once more, we repeat—"American shipowners and shipbuilders, wake-up!" The American Hawaiian Steamship Co. already is on the job as page 202 will demonstrate.

Questions Regarding Motorships At the Hearings Before the Senate Committee on Commerce

At a recent hearing of the U. S. Senate Committee on Commerce, Mr. Frank C. Munson, of the Munson Steamship Line, New York, was giving his evidence, and the following interesting questions were raised:

SENATOR RANSDELL—How rapidly are you getting with oil-burners?

MR. MUNSON—The majority of the ships built by the Emergency Fleet Corporation are oil-burners.

THE CHAIRMAN (Senator Wesley L. Jones)—Right in connection with that, Mr. Munson, it may be out of line with your thought, but what consideration have you given to the Diesel motorship?

MR. MUNSON—The Diesel motorship has been very carefully considered, and it is a great stride forward for the freight-type of vessel. It is not developed far enough yet to be able to go into the express and passenger business.

SENATOR NELSON—Have you had any experience with concrete vessels?

MR. MUNSON—No, sir; we have seen one or two; the "Faith," for example, but we do not think they are practical; they are too large as to hull; they never could compete with the ordinary steel vessel.

THE CHAIRMAN—Well, I would like you to go on about this Diesel motor.

MR. MUNSON—The Diesel motorship is the freight-carrying vessel of the world for economy, and for cheap cost of operation for the future, so far as we can see. The only difficulty is a shortage of experts who are able to handle the Diesel-type of engine, and that is our principal difficulty, and what is, I think, holding a majority of the American builders back.

THE CHAIRMAN—Would that be a good line of work for the Shipping Board?

MR. MUNSON—Education of men to handle them?

THE CHAIRMAN—Yes.

MR. MUNSON—Yes; that would be a very good line of work.

THE CHAIRMAN—Do you know whether they are doing it or not?

MR. MUNSON—I do not; but there are a number of American yards to-day that have licenses for building Diesel-type engines, a company in Baltimore has one type, and the New York Shipbuilding Co. has another type, and all of those yards are experimenting, and some of them are going to turn out an American-type Diesel ship, and it will be as good or better than any foreign make.

THE CHAIRMAN—That is what I hope!

MR. MUNSON—The Shipping Board has just decided to carry on experiments with a Diesel-driven vessel alongside of an electric-drive vessel for merchant purposes. That is constructive experimentation. Those two vessels are being built on the same ways now.

YET ANOTHER SWEDISH SHIPOWNING FIRM ADOPT MOTORSHIPS

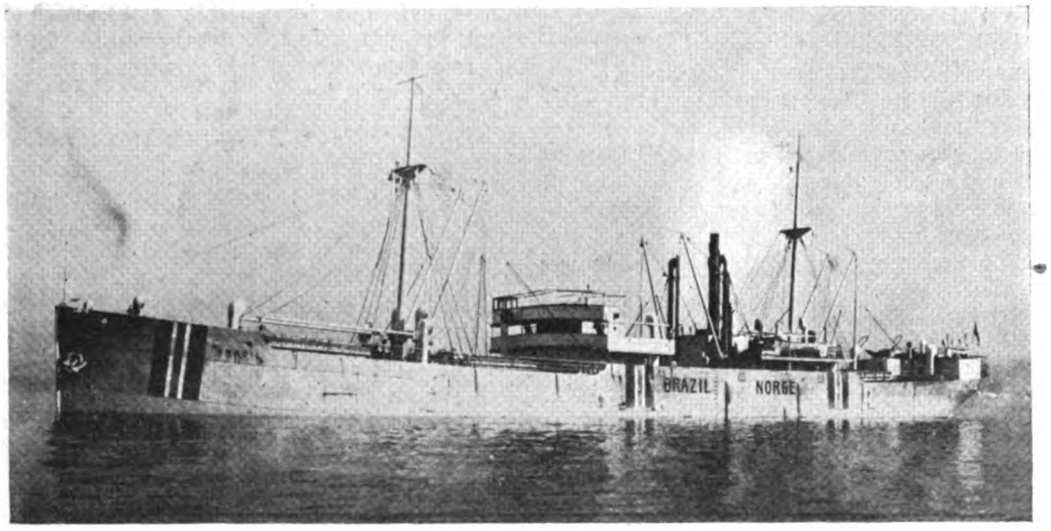
A contract has been placed for a Diesel-driven motorship of 6,500 tons d.w. with the Kockums Mek Verkstad, of Kockums, Sweden, by the Svenska Lantmannen's Rederi A. B. (Swedish Farmers S. S. Co.) Previously this firm have been steamship owners. Two 1,450 i.h.p. Werkspoor-Diesel engines will be built under license and installed in this ship. The owners have applied to the Swedish government for a loan of Kr. 3,000,000 to meet the cost of construction.

TRANSATLANTIC COMPANY'S MOTORSHIP SERVICES

The Transatlantic Company has been maintaining a monthly service between Sweden and Java with their motorships. The company now has decided to establish regular motorship service between Sweden, Hamburg and Java. In addition to the "Bullaren" and "Tisnaren" the new 9,400 ton 14-knot motorship "Elmaren" will be placed in service.

MOTORSHIPS BUILDING AT THE GOTAVERKEN

Now on order at the Götaverken of Goteborg, Sweden, are 13 motorships aggregating 105,100 tons d.w.c. This list does not include the Diesel vessels recently launched, such as the "Stureholm," "Tisnaren," "Balboa," "Buenos Aires" and the "Elmaren," but are additional craft on order.



The motorship "Brazil," one of the Diesel-driven cargo ships operated by Mr. Fred Olsen of Christiania, Norway.

MOTOR POWER IN THE PACIFIC COAST FISHING FLEET

The halibut boat "Harriet E" owned and operated by the Sooke Harbour Fishing & Packing Co., Ltd. of Victoria, B. C. and powered with a 100 h.p. Fairbanks Morse heavy oil engine recently completed her second year of successful operation in British Columbia waters. She is 81 feet in length, has a 17 foot beam and a draft of 11 feet. In a trial trip conducted by engineer P. G. Graignic, the "Harriet E" made an average speed of 9.85 miles an hour while the engine consumed an average of 8½ gallons of Union Diesel Oil an hour. Officers of the Sooke Harbour Fishing & Packing Co. are highly gratified with the results obtained with this type of motive power both from the standpoint of service and economy of operation.

A number of other vessels along the Pacific coast are being equipped with engines of the same type as the one used in the "Harriet E." Among those being powered with 100 h.p. Fairbanks Morse engines are the cannery tender "Carlisle" owned by the Carlisle Packing Co. of Bellingham, Wash., and the "Fredrick" which is being built by the Western Boat Co. of Tacoma for the Alaska Fish Co.

Cannery Tender "Harriet E." Thousands of such boats are engaged in the fishing business on the Pacific Coast of the U. S.

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Sulzer Two-Cycle Engines and the Propulsion of Cargo Boats

Comparison with Four-Cycle Diesel Engines, Steam-Reciprocating Engines and Steam-Turbines

(Specially Prepared by Sulzer Brothers)

[While engineering firms frequently contribute letters to technical publications, a lengthy article is a *rara avis,* so the following contribution from the important Swiss company of Sulzer Frérés no doubt will be read with the greatest of interest. In addition to having one of the largest Diesel-engine plants in Europe, Sulzers also have a large output of steam machinery, which makes their views on the comparisons all the more interesting. Probably there are many points with which makers of four-cycle engines will be unable to agree, just as the two-cycle engine builders differed from the opinion of Mr. Torian's remarks in our issue of last January. Therefore we open our columns to other manufacturers and shipowners for comments on Sulzer's article.—*Editor.*]

So much has lately appeared in the technical press on the use of four-cycle and two-cycle Diesel-engines for the propulsion of ships, that we think it opportune to give some particulars of the Sulzer two-cycle engine and its suitability for propelling large cargo-boats. It is here compared with the four-cycle engine and also, in certain cases, with steam-recriprocating-engines and steam-turbines.

The performance of an engine is most clearly represented by indicator-diagrams. Figure 2 gives diagrams taken on a two-cycle and on a four-cycle engine for the same time "t." As there were 20 revolutions of the crankshaft in the time "t," there were only 10 working strokes made by the four-cycle as against 20 by that of the two-cycle engine. The two-cycle engine then makes exactly double the number of working-strokes as the four-cycle in the same period of time, and the effect of this on the relative dimensions of two machines of the same power can easily be imagined.

In order that a correct judgment may be formed of the relative dimensions of engines of these two types, sections through the cylinders of a two-cycle and a four-cycle engine of the same brake horse power are given in Figs. 3 and 4. The left hand figure is from the latest design of Sulzer two-cycle marine engine. The scavenging-pumps for this engine are turbo-blowers, driven independently from the main engines, as adopted with some large sea-going vessels. The main engines thus do not have to drive the scavenging-pumps and can therefore deliver more power to the propeller. Another typical feature of this design is the well-known system of introducing the scavenging-air into the cylinder through ports in the cylinder walls. The double row of inlet ports is controlled by the working-piston, and the upper row also by a rotary-valve in the scavenging-air receiver. A further development in the design of this engine is the inclusion of the fuel, starting, and safety valves in one common valve-case. This permits of the cylinder-head being designed with only one opening and being made absolutely symmetrical about its

Fig. 1. Corner of the Diesel-engine erecting-shop at the Sulzer plant in Winterthur, Switzerland.

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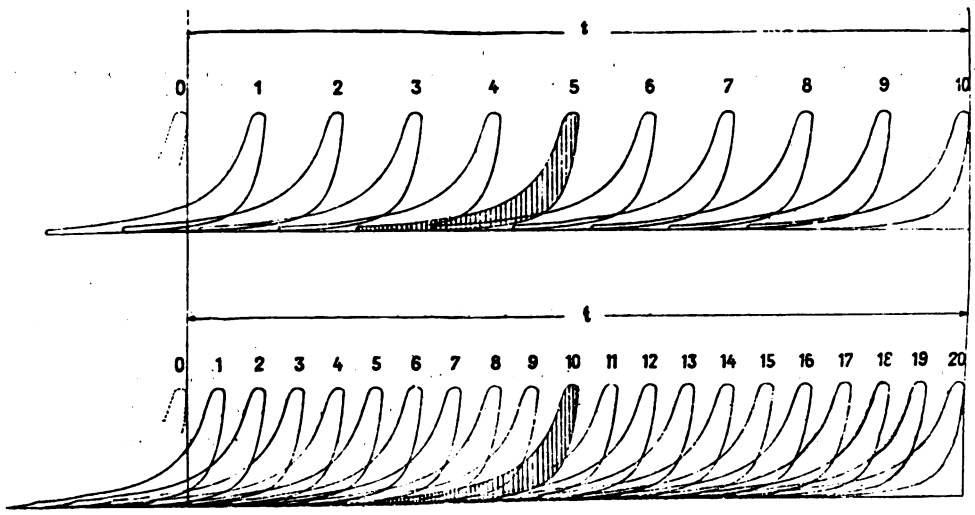

Fig. 2. Continuous indicator-diagrams taken on four-cycle and two-cycle Diesel engines. Comparison of indicated h.p. for 20 revolutions.

central axis, a form ensuring uniform expansion when in use, and therefore avoiding the risk of heat-cracking. The simplicity of the reversing-gear can also be seen from the illustration.

For comparison of the above with the design and dimensions of a four-cycle engine, the section given in fig. 4 has been taken from a well-known make. The difference in cylinder-volume strikes one at once. Also the cylinder-head, with its many valves, compares poorly with the Sulzer two-cycle cylinder-head. As a general rule it may be said that the linear dimensions of a four-cycle engine are about 1.28 times as great as those of a Sulzer two-cycle with independently driven scavenging-pumps: surfaces; also the piston-pressure per cylinder, is about 1.64 times as great, while all cubic measurements are about 2.1 times larger.

The conclusion to be drawn from these figures is obvious. The four-cycle engine will occupy more space in the ship, and surfaces—where work may be lost in friction and where lubrication is required—are larger. It is also clear that separate parts of the two-cycle engine will be much more easily handled owing to their lighter weight, corresponding to their smaller dimensions. This is no slight advantage, as there is never too much space to spare in a ship's engine room. It is assumed that the two machines illustrated in figs. 3 and 4 run at the same speed; but this required that the four-cycle engine, in consequence of its longer stroke, has a higher piston-speed.

On the other hand, in the two-cycle engine, the driving-gear and the cross-head are subjected to more frequent changes of stress in consequence of there being double the number of working strokes in a given time. The cam-shaft also, in the two-cycle engine, must turn twice as fast as in the four-cycle; but it must not be forgotten that in the Sulzer design the moving masses in the valve-gears are very much smaller, especially as heavy inlet and exhaust valves are entirely absent, and there remain only the small fuel and starting valves to be controlled. If one weighs the pro and cons of these two systems, a possible basis of comparison, admitting a somewhat higher piston-speed for the four-cycle engine, can be obtained, which takes account of all the special features of the two-cycle engine.

Figs. 3 and 4 also show where the lifting gear must be placed in the ship in order that the piston and driving gear may be raised clear of the cylinder. In the case of the four-cycle engine, the parts must be drawn up much higher, and therefore the traverse must lie higher in the ship, in order to give the necessary clearance for moving parts about during fitting or overhauling. This, however, weakens the rigidity of the ship and necessitates strengthening the hull elsewhere.

In order to avoid the troubles which would be inevitable in the four-cycle engine if the cylinders were larger, designers have been compelled to construct large units with as many as eight cylinders. This, however, requires that the engine should be very long, besides necessitating a great increase in the number of separate parts, such as valves, valve-gear, driving-gear, etc., making the working and care of the machinery much more troublesome and complicated. It is also quite possible that the vibration caused by such engines with their many cranks may attain dangerous proportions; a risk which of course should be absolutely avoided in marine practice. But, in spite of these drawbacks, such small cylinder dimensions as in the two-cycle engine cannot be attained by the four-cycle.

In order to get a general idea of the relative value of the different designs of engines, everything necessary to a complete installation must be considered. In addition to the main-engines, there are the auxiliary-engines for various purposes, the shafting with the propeller, all the piping, the gangways, and gratings, as well as the pumps for bilge-water, ballast, fire-extinguishing, fresh and sea water, fuel and lubricating oils. The distilling-apparatus, refrigerators, heating-apparatus, and the electric-installation for lighting and power purposes should also be considered.

Figs. 5 and 8 show installations of such complete power plans with all requisite auxiliary machines. Figures 5 and 6 show the space taken up by the machinery in twin-screw boats, figures 7 and 8 in single-screw boats. In figures 5 and 7 the engines are four-cycle; in figures 6 and 8 two-cyle. In each case the main engines are of 3200 B.H.P. Beside each figure is a table of weights of the various parts and also of the space necessary for them. These latter figures take account of the size of the fuel tanks capable of holding fuel for 50 days' working. The figures assumed for fuel consumption are, in each case, figures actually arrived at in practice.

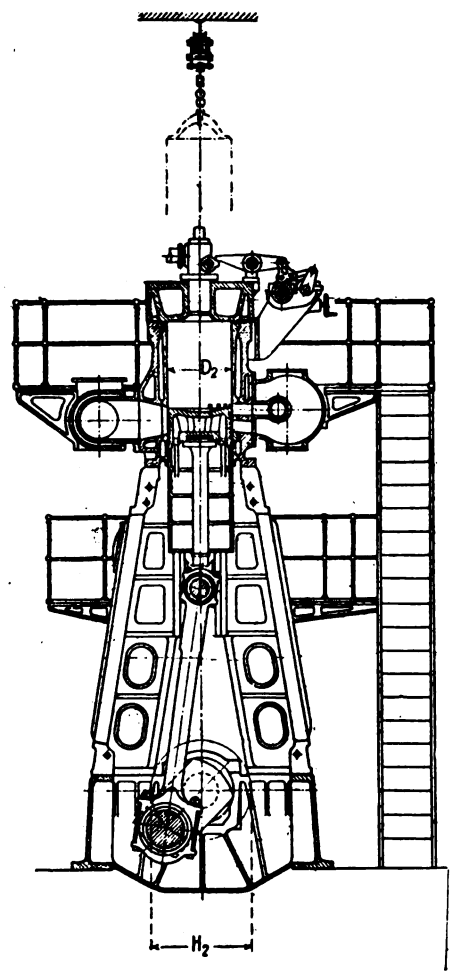

Fig. 3.

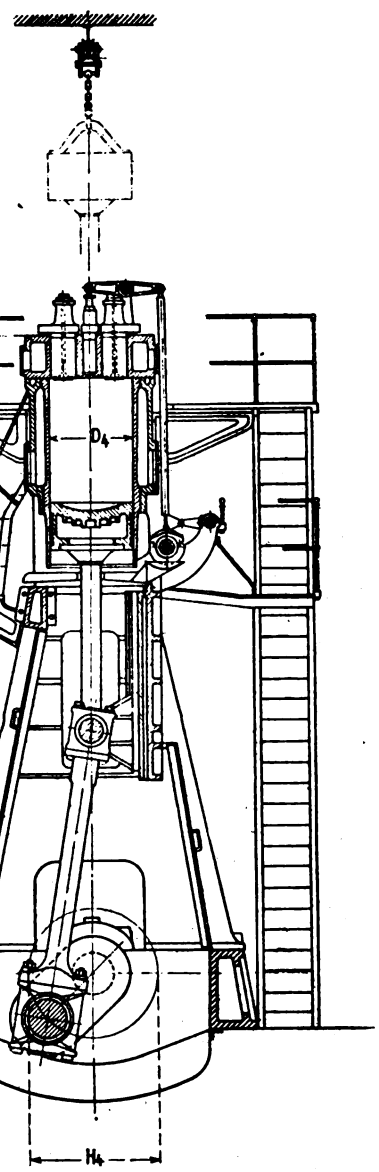

Fig. 4.

Sulzer two-cycle and a four-cycle engine of the same power.

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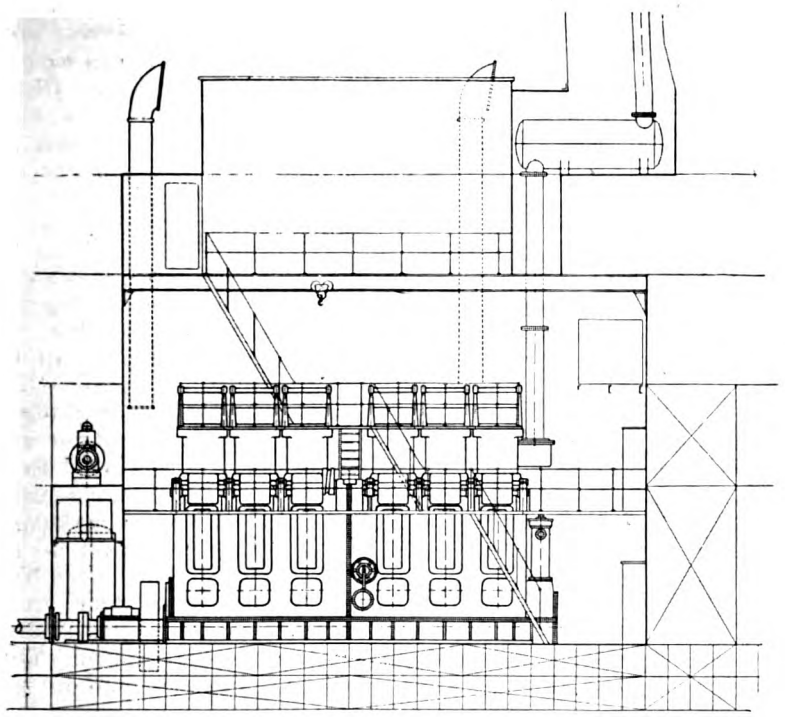

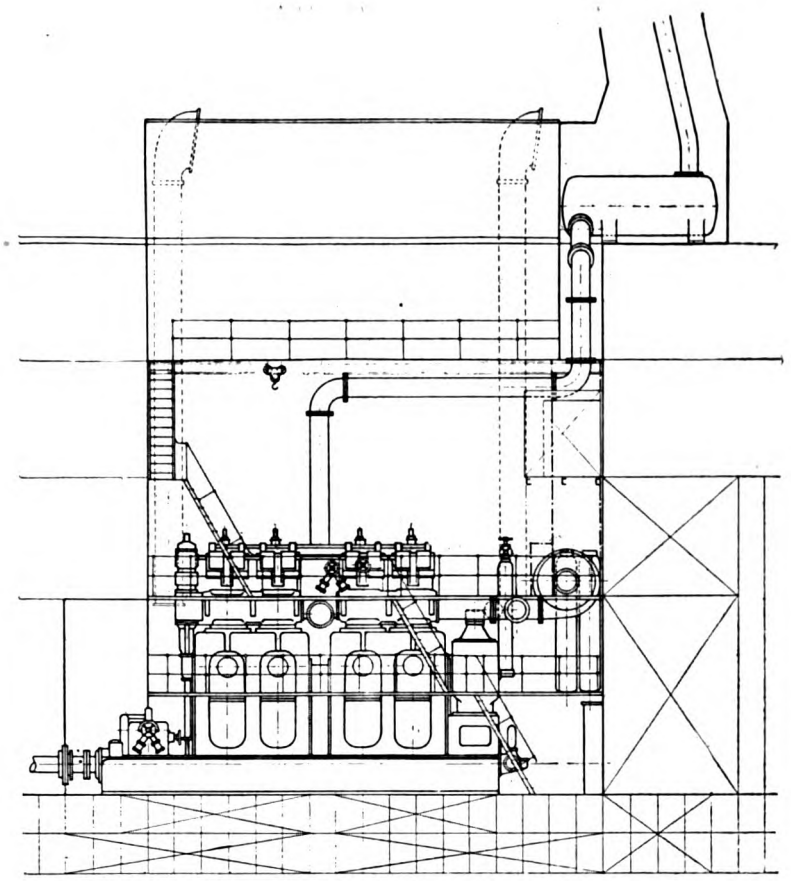

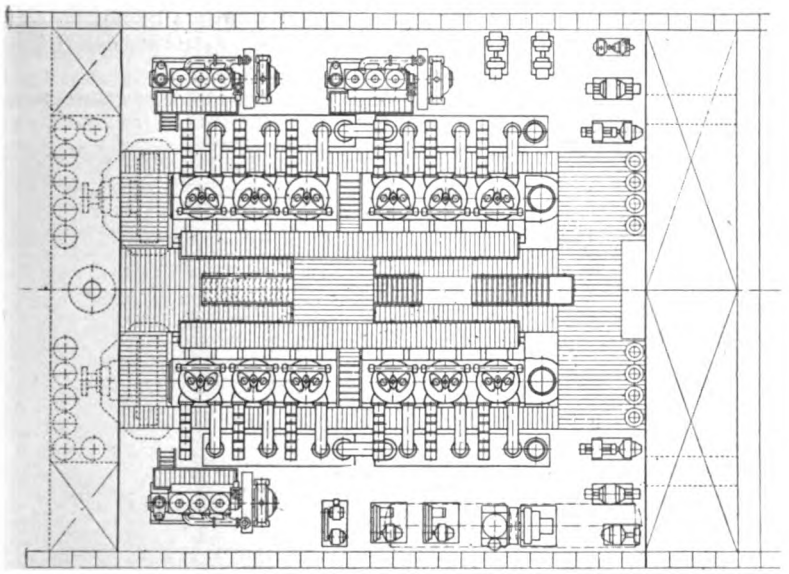

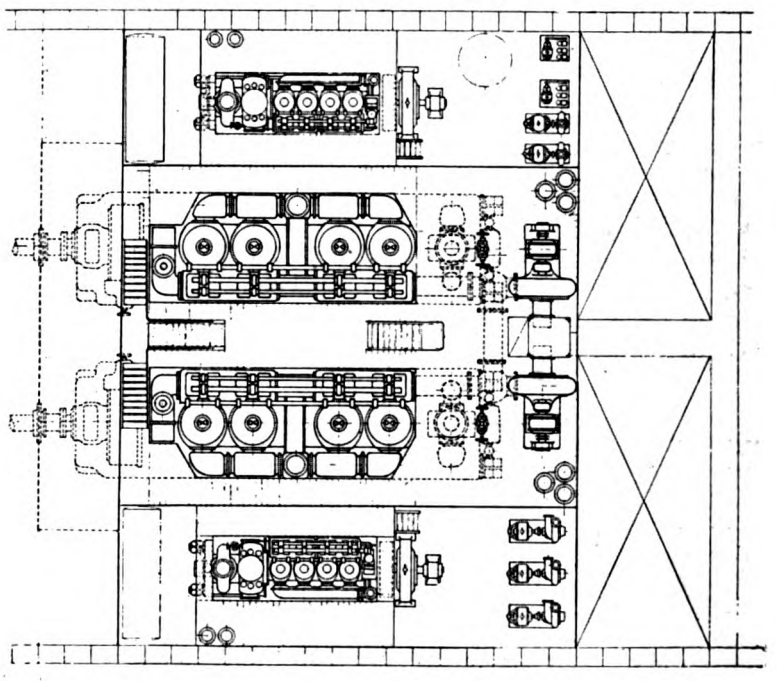

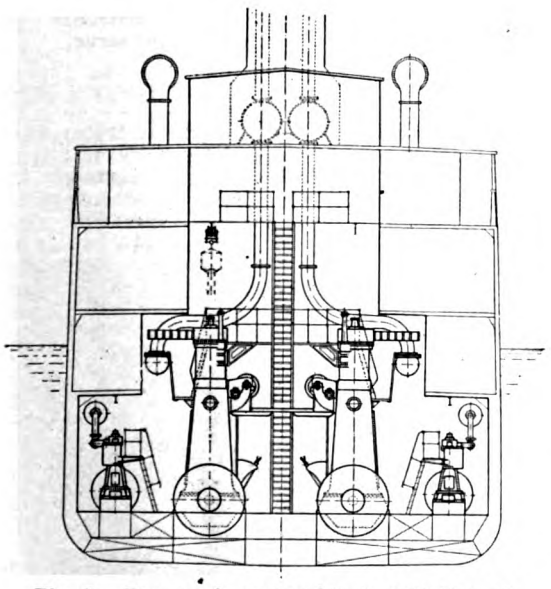

Fig. 5. Four-cycle cargo-ship installation of 3200 shaft h.p.

The length of the engine room, when the propeller speed is 85 revs. per min. is

In twin screw boats

With four-cycle engines.....18.0 m. 59.0 ft.
With two-cycle engines.....14.1 m. 46.3 ft.

In single screw boats

With four-cycle engines.....24.5 m. 80.4 ft.
With two-cycle engines.....19.0 m. 62.3 ft.

We see from the above that in both cases the engine room for four-cycle engines requires to be very much longer than that for two-cycle engines.

But the superiority of the two-cycle engine over the four-cycle is still better shown by comparing the cubic contents of the engine room. The figures are as follows:

For twin-screw boats		
With four-cycle engines	2687 m^3	949 Reg. Tons
With two-cycle engines	2030 m^3	717 Reg. Tons
For single-screw boats		
With four-cycle engines	3773 m^3	1332 Reg. Tons
With two-cycle engines	2897 m^3	1023 Reg. Tons

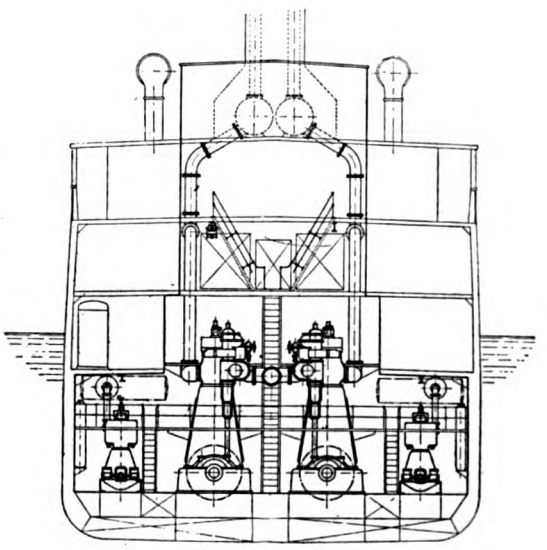

Fig. 6. Arrangement of two-cycle Sulzer engine of same power as in Fig. 5.

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Fig. 5.—3200 B.H.P. Four-Cycle Diesel-Engines and Auxiliaries for Twin-Screw Cargo-Boat
2 Main Engines, each 6-Cylinder. Cylinder Bore 30½ ins. (775 mm.); Stroke 49¼ ins. (1250 mm.); Speed 85 r.p.m.

Machinery	B.H.P.	Tons	Weight In per cent of similar 2-cycle installation.
Main Engines Complete	2x1600	876	208%
Auxiliary Power-Plant	3x100	45	64%
Piping, Floor-plates, Gangways, Handrails and Gratings in Engine Room and Funnel.		84	140%
Electric and other Auxiliary Installations; Water and Oil in the Engines and Piping Equipment according to Inventory		114.5	137%
Piping outside the Engine Room		50	100%
Shafting and Propellers		175	125%
Total Machinery	3500	1344.5	163%

Space required, 949 Reg. Tons=2687 cb. m.=132.5% of that for corresponding two-cycle installation.

Fig. 6.—Two-Cycle Sulzer Diesel-Engines (of the same Power as the Engines in Fig. 5) for Twin-Screw Cargo-Boat
2 Main Engines, each 4-cylinder. Cylinder Bore 26¾ ins. (680 mm.); Stroke 43¼ ins. (1100 mm.); Speed 85 r.p.m.

Machinery	B.H.P.	Tons	Weight In per cent of similar 4-cycle installation.
Main Engines Complete	2x1600	420	48%
Auxiliary Power-Plant	2x410	70	156%
Piping, Floor-plates, Gangways, Handrails and Gratings in Engine Room and Funnel.		60	72%
Electric and other Auxiliary Installations; Water and Oil in the Engines and Piping. Equipment according to Inventory		84	73%
Piping outside the Engine Room		50	100%
Shafting and Propellers		140	80%
Total Machinery	4020	824	61%

Space required, 717 Reg. Tons=2030 cb. m.=75.5% of that for corresponding four-cycle installation.

The extra space required for fuel on board a ship with two-cycle engines on account of their slightly higher consumption is 837—815 m^3=22 m^3 corresponding to a difference in weight of 19 tons in round figures, and it is interesting to note how insignificant this is in comparison with the difference in weight of the two types of machine and the difference in the space occupied.

The weight of the complete machinery in the boats under consideration is—

—for twin-screw ships

With four-cycle engines..... 1344.5 tons
With two-cycle engines..... 824.0 tons

—for single-screw ships

With four-cycle engines..... 1263.0 tons
With two-cycle engines..... 775.0 tons

It is particularly the comparison of these weights which shows the superiority of the ship with two-cycle engines over one with four-cycle. The difference in weight is about 500 tons in the single-screw example, and over 500 tons for the twin-screw, that is over 335 lbs. per B.H.P.

In a cargo-vessel of given displacement, it is important to know what is available for freight after allowing for the weight of the ship and all machinery. This amount is the factor which determines the earning capacity of the ship. As weight lost for cargo-carrying purposes is the weight of the ship itself, together with all the necessaries for a certain radius of action, fuel, water, lubricants, etc. To these must of course be added the crew and their provisions. [*This is the reason why "Motorship" has endeavored to impress upon shipowners the fact that the term dead-weight-capacity is obsolete when comparing steamships with motorships, and that all ships should be sold or purchased at so-much per net-cargo-capacity-ton, when fuel, water and stores for a 10,000 miles voyage are aboard, but the fuel, water, etc., should not be included in the net-cargo-tonnage figures.—Editor.*]

It is also necessary to differentiate between weights which are invariable during the voyage and those which are variable. To the first belong the ship itself with all the machinery, fittings and furnishings. Variable is everything used up in the working of the ship, particularly the fuel used for propulsion, power, lighting, and heating. These weights depend almost directly on the length of the voyage. Cargo-boats which make only short voyages and are often in port do not require to carry much fuel. They often have the opportunity of renewing their stock. Ships which make long voyages are, in general, not in this happy position. They must often make long distances without any stop, and besides that, at many ports it is impossible to take in fuel, merely on account of its prohibitive price. Many large cargo-boats have therefore a radius of action of 30 to 60 days and more, without needing to renew their fuel supply.

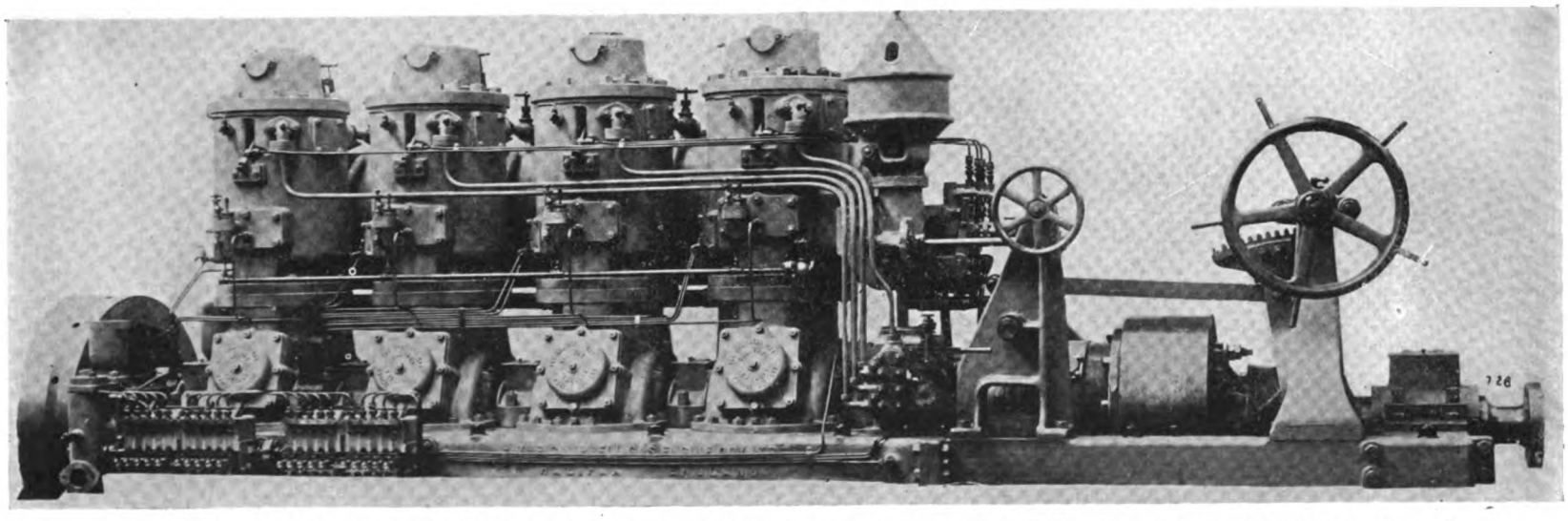
(To be continued in the April issue of "Motorship")

The Densil-engined auxiliary schooner "Nykobing," described in a recent issue.

PRICES OF OIL AND COAL

Commenting on the question of controlling the profits of bunker-coal in his address at the meeting of the P. & O. Steamship Co., Lord Inchcape pointed out that before the war prices were 23s. a ton, whereas under Government control it costs to-day 105s.

He also referred to the oil companies and their prices, and stated that the Anglo-Persian Co., which is a subsidiary of the Royal Dutch Shell Combine, promises a profit of 100 per cent. for the present year. He had the honor to represent the British Government, which holds two-thirds of the ordinary shares, on the Board of Directors.



One of the four 160 s.h.p. Campbell two-cycle type surface-ignition heavy oil engines installed in the British motor monitor "M. 24."

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Marine Engine Developments

Comments on the Marine Diesel-Engine for Merchant Ships

By ALEXANDER CLEGHORN

(Engineering-Director, The Fairfield Shipbuilding Co., Govan, Scotland)

[Readers of "Motorship" may remember that in our issue of January, 1918, we commented on Mr. Cleghorn's remarks given in an address before the Institution of Engineers and Shipbuilders, in Scotland, as we could not agree with his figures or coincide ourselves with certain statements that he made. We are sorry to see that even since that date Mr. Cleghorn apparently has not made a very extensive study of the modern motorship, and we print an extract from a contribution by him in a recent issue of "Fairplay." However, even his present consumption figures allow a little too much latitude, as we have yet to go aboard a modern large ocean-going four-cycle Diesel-engined motorship with which the fuel-consumption exceeded 0.33 lb. per I.H.P. hour (0.42 lb. approx. per shaft h.p.), *including auxiliaries;* whereas Mr. Cleghorn quotes 0.45 lb. per shaft h.p. hour for the main engines and 0.15 lbs. per shaft h.p. for the auxiliaries, or a total of 0.60 lb., which, of course, is quite incorrect, being 2/10ths of a pound too high. On the other hand, American geared-turbine and reciprocating oil-fired steamers average between 0.95 and 1.25 per I.H.P. hour in actual service, so if British steamers average 0.90 lb. they must be remarkably economical, while their Diesel engines must be extraordinarily uneconomical in comparison with American products. As regards Mr. Cleghorn's remarks on propeller-efficiency, the log of the Ms. "Selene," published in our issue of January, 1920, on Page 24, proves his views to be without substantial foundation.—*Editor.*]

NO summary of recent progress in the Mercantile Service would be complete without a reference to the advent of the oil-engined ship, made possible by the gradual evolution of the Diesel type of engine. A considerable amount of experience has now been gained, and in the cargo-boat to which its application is still limited, it has demonstrated many advantages and perhaps disclosed a few faults. During the war, the internal-combustion engine was largely used for propelling submarine ships, and many engineering firms throughout the country were commissioned to supply parts of these engines, or to assemble these parts into a complete engine ready for installing on board a ship.

Much experience, therefore, has been gained in this way, and now since the war is happily over, the oil-engine for merchant-ship propulsion is being developed by British firms on lines independent of Continental practice. This is only as it should be, and a start having been made, under the progressive policy and fostering care of the British Marine Oil Engine Manufacturers' Association, British manufacturers will keep in the front rank of this branch of the industry.

Before the war, these engines were usually of the single acting four-stroke Diesel type, and involved either very large and heavy parts, or they were made to attain a relatively high rate of revolution, which in turn made the propellers inefficient. In addition to these disadvantages, others of a metallurgical nature presented themselves. The cylinder head or cover was generally a very complicated casting, containing the valves for induction, exhaust, fuel-inlet, and starting-air, and was necessarily subject to high temperatures and stresses. Moreover, complications in the valve-gear for these valves, both for ahead and astern running, were a source of much trouble and cost, so much so that there was constant liability to a subsequent breakdown.

It would therefore be a great advance if these heads or covers could be done away with; and at least three British firms are now producing engines in which these are entirely eliminated by the adoption of the two-stroke opposed piston type. Here, the pistons, by uncovering ports in the cylinder walls, perform the functions of the induction and exhaust valves, and the oil-fuel injection and starting-air valves operate through the cylinder wall between the piston heads. The gear actuating these valves is of a very simple nature, and otherwise the construction of the engine is in accordance with established practice for good reciprocating steam engines.

The adoption of the two-stroke cycle reduces the size and weight, and renders the engine suitable for efficient installation in most types of cargo-ships. The simplication of construction will also remove the objection which many shipowners have to the oil engine, as it was found impossible to maintain a complicated piece of mechanism without a large repair bill, which generally was accompanied with delays involving further loss.

The necessity for economy is ever more urgent, and owing to the high cost of coal and oil fuel, the low consumption attainable with the oil engine is a recommendation which strongly appeals to all. The oil fuel consumption in a geared turbine installation is approximately 0.9 lbs. per S.H.P. per hour, but with the oil-engine it should not be more than 0.45 lbs. for the main propelling engines, to which has to be added approximately 0.15 lbs. for auxiliary purposes. A reduction of about 33 per cent. in the fuel-consumption is therefore obtainable in the case of the two-stroke oil engine as compared with the geared-turbine, and as the former runs at slow speeds compared with the four-stroke type, there is, on this account, no impaired propeller efficiency.

Oils of widely different compostion may now be used, varying from refined petroleum to crude-oil containing about 45 per cent. of asphaltum; and, with this range to choose from, the shipowner can run the oil-engined vessel on practically any of the world's trade routes without requiring special bunker capacity to suit oil-fuel depôts. One of the disadvantages under which he labored in former years has now been removed by the installation of oil-fuel supplies at the principal coaling-stations.

Voyages of Ocean Motorships

Record Issued by Bureau Veritas

Owing to the excellent idea adopted by the "Bulletin Technique du Bureau Veritas" the question of the reliability of large ocean-going Diesel motorships now in service no longer can be disputed. In each issue of the "Bulletin" the dates of arrivals and departures of about a dozen Diesel-driven vessels covering a period of the last six months or more are given, so the time spent in port and at sea is clearly shown, also the average speeds can be worked out. In their January, 1920, issue the voyages of the "Selene," "Peru," "Sabara," "Secundus," "San Francisco," "Santa Margherita," "Valparaiso," "Selandia," "Siam," "Suecia," "Tisnaren" and "Tongking." We give two examples; one being a two-cycle engined ship, "Secondus," the other, "Tisnaren," having four-cycle motors.

MOTORSHIP "SECUNDUS"

Constructed 1919. Net tonnage 4,499 tons.
Engine Builders, Blohm & Voss, Hamburg, 3,000 h.p.
Owners, French Government.

VOYAGES

Port Français-Rio-de-Janeiro-Montevideo

Dep....	Port Français	May
Arr....	Rio-de-Janeiro	June 8
Arr....	Montevideo	June 20

Montevideo-Bahia-Blanca

Dep....	Montevideo	
Arr....	Bahia-Blanca	Aug. 12

Bahia-Blanca-Brest-Anvers

Dep....	Bahia-Blanca	Aug. 22
Arr....	Saint-Vincent	Sept. 9
Dep....	Saint-Vincent	Sept. 11
Arr....	Brest	Sept. 20
Arr....	Anvers	Oct. 10

The "Secundus," however, was completed in 1914—not in 1919 as stated—and after one voyage was laid up in Hamburg, Germany, owing to the war. We note that the French Government have secured her, as they have the motorships "Wotan," "Sabara" and "Christian X."

MOTORSHIP "TISNAREN"

Constructed 1918. Net tonnage 574 tons, d.w.c. 9,400 tons
Engine Builders, Gotaverken, Goteborg (B.&W. type) 4,000 h.p.
Owners, Transatlantic Steamship Co., Goteborg

VOYAGES

Batavia-Göteborg

Dep....	Batavia	Mar. 27
Arr....	Sourabaya	Mar. 28
Dep....	Sourabaya	April 8
Arr....	Suez	May 4
Passed.	Gibraltar	May 12
Arr....	Newcastle	May 18
Arr....	Göteborg	May 22

Göteborg-Extrême-Orient

Dep....	Göteborg	June 23
Dep....	Port-Said	July 5
Arr....	Batavia	

Batavia-Europe

Dep....	Batavia	Aug. 5
Dep....	Balik-Papan	Aug. 22
Passed.	Perim	Sept. 7
Arr....	Suez	Sept. 12
Arr....	Göteborg	Sept. 27
Arr....	Malmo	Oct. 20

If shipowners will trouble to work out the sea-speed of the "Tisnaren" we think they will find that the average speed for the three voyages exceeds 12 knots, while the stops in ports were very short, absolutely proving unusual reliability, even if compared with steamships.

The "Bulletin" is issued monthly, price 25 francs per annum, and can be obtained from the Bureau Veritas, 17 State Street, New York City, or from the Bureau Veritas, 31 Rue D'Offemont, Paris, France. We take the opportunity to congratulate Mons. J. Delimal, the editor, on this most excellent feature, which we trust will be a permanent part of the "Bulletin." Only pressure on our space prevents us from reprinting the voyage records of all these motorships.

ENGINEERS FOR MOTOR VESSELS

From time to time we hear reports that shipowners cannot find engineers to operate the machinery of their vessels. On the other hand licensed motorship engineers call at this office and ask us if we know of any openings, as there seems to be no jobs open for them. At various times during the past year or two the following motor engineers have registered at these offices:

L. E. Ewing,
805 London Bldg.,
Vancouver, Canada.

John Cahill,
99 Clermont Ave.,
Brooklyn, N. Y.

Geo. S. Whipple,
1845 Coney Island Ave.,
Brooklyn, N. Y.

Wm. Kinghorn,
25 South St.,
New York City.

G. F. Taylor,
Ocean Assn. Mar. Engrs.,
17 Whitehall St., N.Y.C.

Hy. J. Broggel,
Mar. Engrs. Ben. Assn.,
Grand Trunk Dock,
Seattle, Wash.

J. D. Troland,
Care of M.E.V.A. No. 80,
15 Whitehall St., N.Y.C.

Geo. A. Johnston,
158 S. Elliott St.,
Brooklyn, N. Y.

Walter E. Buttle,
198 Washington Ave.,
Brooklyn, N. Y.

Geo. Scott,
Ocean Assn. Mar. Engrs.,
15 Whitehall St., N.Y.C.

E. Nilsen,
172 Carroll St.,
Brooklyn, N. Y.

Philip G. Williams,
1539 76th St.,
Brooklyn, N. Y.

Mar. Diesel & Gas Engrs. Assn.,
S. A. Walker, Sec'y,
102 Grand Trunk Dock,
Seattle, Wash.

Charles F. Garrow,
106 Lord Ave.,
Bayonne City, N. J.

We suggest that shipowners who are in need of engineers communicate with the above men. If motorship engineers will register their names and addresses with us (there will be no charge) we will be glad to file them for the benefit of shipowners who may approach us.

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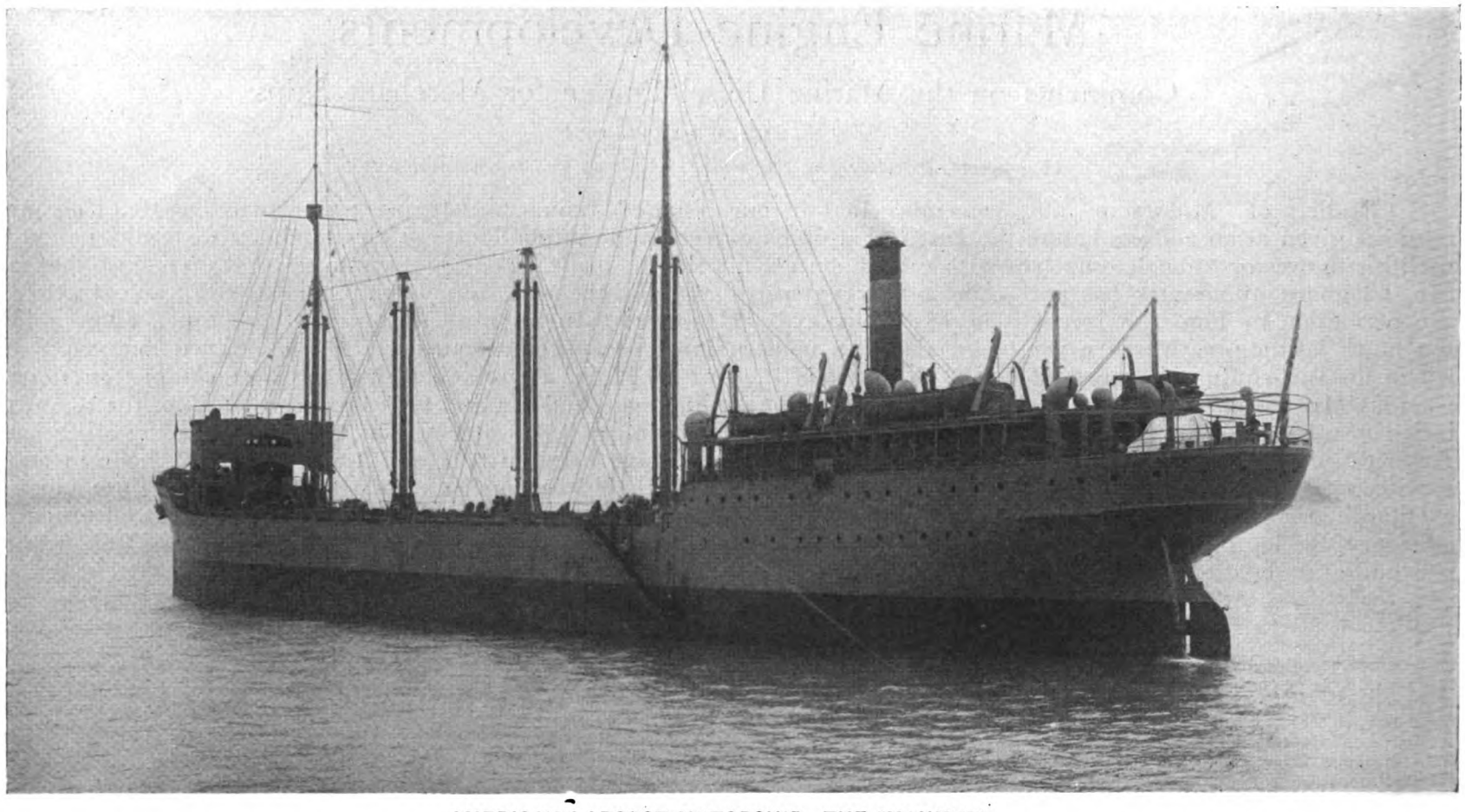

AMERICA'S LARGEST MOTORSHIP—THE "MAUMEE"

She is of 15,000 ton displacement. Her engines together have developed about 6,100 b.h.p. (7,800 i.h.p.) on the test-bed. Speed about 14½ knots. Length 455 ft. by 56 ft. beam and 26 ft. draught.

Operation of the Navy Tanker "Maumee"

Designed in 1912 and Completed in 1916, the Diesel-Engines of this U. S. Navy Motorship Still Have the Largest Cylinder-Output for Existing Merchant-Type Propelling Machinery

DURING the war nothing could be said about the operation at sea of the Diesel-driven tank-ship "Maumee" of the U. S. Navy, but ship-owners have displayed interest in her and frequently have asked us how she has been performing. The veil of silence has now been lifted and results show that she has been moderately successful, which was better than we anticipated under the circumstances of her design and construction.

The "Maumee" is very noteworthy by reason of being one of the largest motor-tankers afloat, and by reason of having the highest-cylinder output of any marine Diesel-engine in actual service, although she was completed nearly four years ago. The maximum cylinder output obtained on tests at the Brooklyn Navy Yard was 508 shaft h.p. (about 650 i.h.p.) equivalent to approximately 585 steam i. h. p. at 140 R. P. M. But, the rated-output of *each* of her six-cylinder engines is 2500 shaft h.p. at 130 R.P.M. with a bore of 25.3 inches and a stroke of 39.37 inches, or say the equivalent to about 3200 steam i.h.p. The engine is of the two-cycle direct reversible type, and was designed by the Nürnburg Works of the M. A. N. of Germany, who at that time unfortunately had no practical sea-going experience with high-powered heavy-duty marine Diesel-engines, so the design was more in the nature of an experimental development. Also during the four years that elapsed between the design and completion of the engine much water passed under Brooklyn Bridge. However, much valuable information must have been secured, and this we think Secretary Daniels would do well to make available to American Diesel-engine builders.

The motorship "Maumee" has the following dimensions:

Loaded-Displacement	15,000 tons
Length, B. P.	455 feet
Breadth	56 feet
Draught (Loaded)	26 feet
Speed (Designed)	14½ knots
Shaft h. p.	5,000 h.p.
Dia. of Crankshaft	16½ in.
Daily Fuel Consumption	13 tons
Piston Speed	853 ft. per min.

Regarding her operation the following letter from the United States Navy Department will show that her performances can be said to be reasonably good, if we take into consideration the fact of her machinery being a great jump in power from anything then afloat, and that her designers had little technical material of value to work from, and so much was calculation and guesswork.

NAVY DEPARTMENT
Bureau of Steam Engineering.

Dec. 30, 1920

To the Editor of "Motorship",

Sir:—

As you probably know, the plans for the engines of the "Maumee" were bought in Germany in 1913 from the M. A. N. Company who were then considered to be farthest advanced in Diesel Marine-Engine building although their greatest experience perhaps had been derived from stationary plants. The building of these engines, the largest power-output per cylinder then and now, was experimental in nature and was not expected to be an unqualified success, but to form a basis for acquiring Diesel-Engineering knowledge for future designing and operating.

The vessel was commissioned October 23, 1916, and at the outbreak of the war had cruised about 22,000 miles. The imperative demands for the services of the vessel created by war conditions upset the routing for overhaul that had been established and the vessel was driven as hard as possible throughout the war and in June of this year it was necessary to lay the ship up for extensive overhaul. The vessel will soon be in service again completely overhauled, with some alterations to her auxiliaries occasioned by past experience.

Since commissioning, the vessel has cruised approximately 100,000 miles fueling the fleet, or destroyers on convoy and carrying cargoes of oil overseas involving several passages through the submarine zone at full power. The economy of the plant has been very good and her maneuvering qualities in going alongside battleships or in docking-slips have been as good as any steam plant.

Trouble has been experienced at various times due to faults of design and of material that has necessitated considerable outlay in replacements of parts. It would therefore be correct to say that as an operating plant the engines are only "moderately successful." However, the lessons learned as to design and material for future developments have been invaluable.

Very truly yours,

C. W. Dyson,
Rear Admiral.

Washington, D. C., Dec. 30th, 1919.

Complete details and drawings of the engines of the "Maumee" appeared in "Motorship" for February, 1917. We have a few copies left, which can be obtained at a cost of 50 cents each including postage.

THE EX-GERMAN MOTORSHIP "WOTAN"

Diesel-driven Tanker "Wotan," originally owned by the German-American Petroleum Co., is now in the hands of the French Government. The "Wotan" is of 7960 tons d. w. c. and of 2800 i. h. p. and was built by Reiherstieg Schiffswerfte u. Maschinenfabrik, of Hamburg, who, by the way, paid a dividend of 7 per cent. for the financial year 1918 to 1919. She is noteworthy inasmuch as she is a single-screw vessel propelled by a six-cylinder 23.622 inch bore by 43.307 inch stroke Carels-type two-cycle Diesel-engine of 2800 i. h. p. at 100 R. P. M., built under license by the Reiherstieg Schiffswerfte u. Maschinenfabrik.

Importance is attached to the operation of this vessel as the Nordberg Manufacturing Company of Milwaukee, Wisconsin, who are the American licensees for the Carels engine, are now making patterns and castings for a marine type six-cylinder Diesel engine of 3,000 shaft h. p. which, when completed, will be the highest-powered merchant marine-type Diesel-engine in the world. The original designers of the Carels engine were Carels-Freres of Ghent, whose works were stripped of machinery during the war by the Germans.

AMERICAN JUNKERS DIESEL ENGINE

The name of the American Junkers Co., Inc., has been changed to Opposed-Piston Oil Engine Co., Inc. Mr. John A. Harris is the President. The company is related to the International Arms & Fuse Co., Newark, N. J.

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Cammellaird-Fullagar Diesel Marine Engine

An Absorbing but Practical Discussion of this Remarkable Propelling-Mechanism and Its Astounding Claims

(Contributed)

[The following contribution was specially written for "Motorship" by one of the most sound and thorough writers on Diesel oil-engines, and who hitherto has exclusively written for one British engineering publication. Other articles from his capable pen will appear in "Motorship." For this first contribution the author has taken a subject that few men would care to tackle in a similar manner, and our readers will agree that he has handled the description and comments in a most practical and skillful manner. Owing to the drawings mailed us not having arrived, they will be published in our next issue, together with the balance of the article.—*Editor.*]

IT will be a great day in the history of the Diesel engine when the first single crank-shaft marine-engine with a reasonable number of cylinders develops 10,000 i.h.p. and the attainment of that end will undoubtedly be the goal of designers for some time to come, though perhaps it is idle to speculate today as to exactly how it will be done. At present the biggest single crank-shaft unit in successful commercial marine work and excluding stationary units up to some 4,000 b.h.p. in six-cylinders are the twin six-cylinder 25.3 in. by 39.37 in. M. A. N. type American-built two-cycle Diesel engines of the Maumee, which on tests developed about 3,900 i.h.p. (3,050 shaft h.p.) per engine, and the eight-cylinder Burmeister & Wain four-cycle type engines of the British-built ship "Glenapp," giving 3,200 i.h.p. per engine at 120 revs. per minute from cylinders 29.527 in. dia. by 43.307 in. stroke—a long way from the goal!

It is, therefore, of the greatest interest to carefully investigate any design of engine that holds out any hope of a nearer approach to the figure which we have put forward as an ideal which must satisfy us for the moment—and for the moment alone. We are not forgetting that in 1911 1,250 b.h.p. had already been obtained at 150 revs. per minute from a single-cylinder, 32 5-16 in. dia. by 38¾ in. stroke, built by Carels Bros., nor the report that 2,000 horse-power has been obtained from another single-cylinder built by Sulzer Bros. of normal single-acting two-cycle design. If these rumors are true and if the cylinder has shown itself capable of long runs without temperature or other troubles, a six-cylinder unit would already be in view which would fulfil our ideal. Nordbergs of Milwaukee, U. S. A., are building a six-cylinder, two-cycle single-acting marine Carels type Diesel engine of 3,000 shaft h.p. (4,000 i.h.p.), and the Worthington Pump Company, of Buffalo, U S. A., have almost completed a six-cylinder four-cycle 2,000-2,400 i.h.p. marine Diesel engine, while James Craig is constructing a six-cylinder four-cycle marine engine of 1,500-2,000 shaft h.p.; also, Doxfords of Sunderland are bulding a 3,000 h.p. engine in four-cylinders, while the Bethlehem Shipbuilding Co. of Bethlehem, have completed a six-cylinder 2,500 shaft h.p. engine for an ore-carrier.

With all the seven years of experiment to which the Sulzer cylinder has been subjected we do not gather, however, that such an assumption as mentioned above can yet be made and we feel that the realization of our (temporary) ideal is more likely to be found in some radical departure from normal design. However that may be, Messrs. Cammell Laird & Co., of Birkenhead, England, make such startling claims for the "Cammellaird-Fullagar" Diesel engine of which they are the protagonists, that it is worthy of the closest investigation, even though the largest unit actually built and run up to the present does not carry us any further so far as actual power output is concerned. Orders for motorships with this engine have been placed by well-known Liverpool shipowners.

The Fullagar engine is an adaptation of the Oechelhauser two-cycle gas-engine in one of its features, combined with what is to our mind a somewhat bold defiance of best practice in design which should aim at the transmission of force as far as possible in a straight line, a feature which at first made us look askance at the engine till we looked more carefully into it.

The Oechelhauser gas-engine had a cylinder consisting simply of a cast-iron tube surrounded by a water-jacket and open at both ends. A ring of ports toward one end served for the admission of the scavenge-air, a corresponding ring of ports at the other end forming the exhaust-ports. The gas was admitted through valves placed in the center of the length of the cylinder bore and combustion took place between two pistons which accordingly were driven apart; one of these pistons uncovered the ring of exhaust-ports and so, without the need for any valves, released the exhaust gases at the proper time, followed by the uncovering of the opposite row of ports by the other piston, thereby admitting, again without the need for valves, a charge of scavenge-air. The outer piston was connected to a crosshead carrying two connecting rods which passed along the sides of the cylinder to two crank pins outside, and opposite to, a central crank pin to which the inner piston was connected by its rod, the three crank pins with their webs forming a single crank-unit, if we may term it so, between a pair of bearings.

There are obvious advantages and there is an equally obvious disadvantage in this arrangement. The outstanding advantage is the elimination of any cylinder-cover which sometimes is a complicated casting and is always a source of anxiety if not of actual trouble. The absence of a cover naturally relieves the cylinder and therefore the framing of longitudinal stresses, though the same result is now very generally obtained in a cylinder of normal design by transmitting the thrust on the cover direct to the bedplate by means of through-bolts or columns.

Another great advantage is the admission of the scavenge-air through a complete ring of ports at the opposite end to the exhause-ports, so that the air can form practically an air-plunger and entirely sweep the cylinder clear of exhaust-gases, whereas the ordinary port-scavenging arrangement, which is now becoming the general practice, renders the formation of pockets in which exhaust-gases can lie undisturbed almost inevitable.

The very form which the cylinder has to take simplifies casting and being of an equal thickness all round at any one point, the temperature stresses cannot cause distortion. The absence of any valves for exhaust or scavenge-air is of course common to most port-scavenging types of two-cycle engine, but the double opposed-pistons, if the two outer rods and the upper crosshead are made of the same weight as the corresponding parts of the center rod do produce a perfect balance of the reciprocating parts without the introduction of a couple, and in theory at all events relieve the bearings of all load beyond that due to gravity. The great disadvantage of the system is the complication and expense of the three cranks and connecting-rods necessary for the one cylinder and how a set of four or six such crank-units all in a row will work in practice at sea has not yet been demonstrated.

In the Fullagar engine this objection has been entirely done away with and only a single crank is required per cylinder, though the cylinder itself retains the same form and the same advantages. To effect this two cylinders are required to form a complete unit and it is this necessity that introduces the one feature to which exception might be taken—though hardly justly—to which we have already referred.

Taking the Oechelhauser engine as we have portrayed it above, there is no reason that we can see why it should not work perfectly well, at the expense of the introduction of a couple, with two cranks at 180 degrees instead of three- provided that what would then be an overhung arm instead of a crosshead on the outer piston were made stiff enough, and ample guide surface were provided to take the consequent side-thrust on the piston; the friction of this guide would probably cancel out that of the third connecting-rod and crank-pin, but the alteration would introduce a small couple owing to the overhang of one crank and would place some load on the bearings.

With modifications, this is indeed exactly what the Fullagar engine is. The crosshead of the outer, or upper piston as we should call it in the case of a marine engine, instead of being an overhung arm placed over its crank in a fore and aft line is once again centrally placed in regard to its piston but in an athwartship's line, and instead of a connecting-rod from each end directly down to its crank, there is a diagonal-rod, one from each end of the crosshead, to keep the strains central and these lead down to a crosshead from which a connecting-rod connects up to the second crank, guide-shoes being arranged to take the thrust of both connecting-rod and diagonal-rod.

Now that engine would, as we have indicated, work perfectly well and would be better arranged for dealing with the forces than the overhung crosshead of the bastard Oechelhauser suggested above, but a good deal of material is introduced for which there is no adequate return. The Fullagar design simply adds two more pistons, two more diagonal-rods with their guides and another cylinder with its fuel valve and the power of the original engine is doubled with only a slight increase in length, none in height or width, and certainly nothing like double the weight. That in effect is a sort of diagrammatic sketch of the system and we will now see how it is carried out.

The two cylinders A and B, Fig. 1, which comprise the unit, are mounted as closely together as either the cranks or the thickness of the cylinder-walls and the water jacket space will allow and the lower piston in each cylinder is connected to its own crank through a connecting-rod in the ordinary way. Then the upper piston of the cylinder A is connected to the lower piston of the cylinder B and the upper piston of B to the lower piston of A through the diagonal-rods shown, so that we get the effect of two complete Oechelhauser cylinders by the simple substitution of four diagonal-rods with their necessary guide shoes for four connecting-rods and their guides and four cranks.

If then the Oechelhauser was good—as we believe it was as carried out in the Doxford low-compression solid-injection engine—how very good should the Fullagar engine be on the above showing? If the assumed objection to the diagonal-rods be analysed it will be found that they correspond to a marked extent to the two outer connecting-rods of the original engine so far as the nature of the stresses to which they are subjected by the transmission of the combustion-pressure are concerned, while in the connecting rods the inertia stresses are heavier. At all events practice has disclosed no actual difficulties beyond the need for very careful work in connection with the machining and erecting of the two guides, that for the diagonal-rods and that for the connecting rods, and this is no hardship in Diesel-engine work. Even if it were it would be a very trifling price to pay for the simplification they result in.

The effect of this combination is that when the combustion takes place between the two pistons in the cylinder "A," the crank of that cylinder is pushed downward, while that of "B" is being pulled upward, while at the same time the pistons in "B" are being brought together for compression and this gives a cushioning effect on the pistons in "A" as they reach the end of the stroke which should tend to sweet running. And not only this, but since when the combustion takes place in the other cylinder "B," the crank of that cylinder is pushed downward, while that of "A" is pulled upward, there are actually two impulses per crank per revolution and we have a double-acting engine brought about in a surprisingly simple and economical manner and without any glands and without exposing the piston to the combustion temperature on both sides, though as the cranks are at 180 degrees, the turning moment is only the same as with a single double-acting cylinder.

The very even turning movement of a 12 cylinder Fullagar-engine as compared with that of a 12-cylinder four-cycle engine is shown in Fig 2 and this should make a very handy engine for entering port and allow of a very low minimum revolution speed, while the reduction in the bending moments will permit of a greater power being transmitted through a shaft of given diameter without any increase in stress. There is not of course the perfect balance of all the reciprocating parts that is inherent in the Oechelhauser system, but the pistons and the diagonal-rods are balanced and the only disturbing element in a single unit is due to the connecting-rods and cranks. These, however, are small and can be eliminated either by adding balance weights to the cranks or by increasing the number of cylinders.

(To be continued in our April issue.)

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Test of 200 H.P. Price-Rathbun Marine Oil-Engine

Marine-Set for Tug Owned by British Guiana Government

WE are enabled to give a rather interesting report made of a solid-injection-type marine oil-engine built at the Price-Rathbun Jones engineering plant of the Ingersoll-Rand Co. of New York, and which has been shipped for installation in a tug owned by the British Guiana Government. Report is as follows:

"Altogether the engine was run over forty hours and a careful inspection when dismantling for packing indicated that all parts were in good condition. The crank-shaft was lifted out and perfect bearings found on all the journals. There was no accumulation of carbon on the pistons, and the piston-rings seem exceptionally tight. One test that was made was to let the engine run down on the compressed-air until it would stop, which was at about seventy-five pounds, then stand until the pressure would rise to eighty-five pounds, then make a few turns and stop again. There was no indication of any material leakage by the rings or elsewhere. The air-supply tanks for the test-block have a capacity of less than five cu. ft., but no indication was given for the need of greater capacity, although many tests were made requiring frequent reversals."

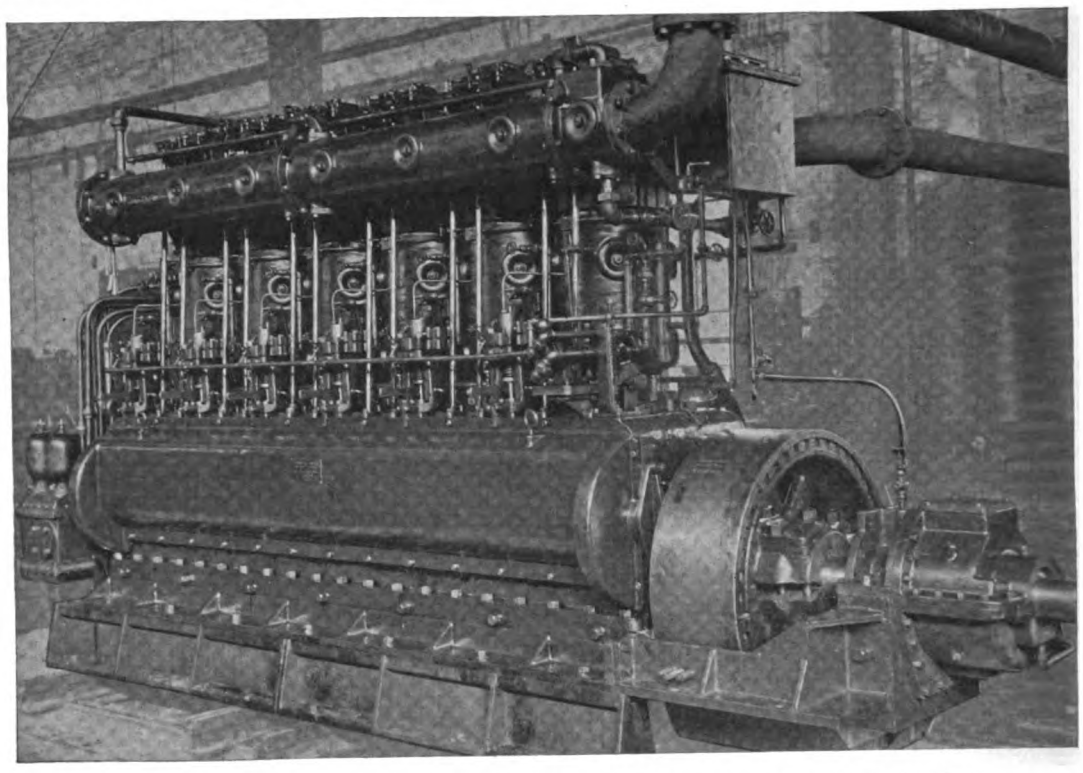
"With the air-pressure between one hundred seventy-five pounds and two hundred pounds, the quick-opening throttle valve cannot be opened and closed so rapidly that the engine will fail to start. The time required for reversing is seven to eight seconds. About five seconds of this time is required for the engine to come to rest, so that the time required to move the fuel control lever to "off," set the maneuvering-wheel "ahead" or "astern"; move the fuel-control-lever to "on," and open the compressed-air throttle-valve is but two or three seconds."

"The positive action of the fuel-injection even at very low speeds is well illustrated by the "stunt" of reversing without the use of the compressed-air. This is accomplished by throwing the fuel control-lever to "on" just before the flywheel comes to rest. If caught at just the right point—and it can be done repeatedly—the engine will rock once and then start in the reverse direction and with perfect smoothness and freedom from jar or shock."

"The engine in general seems very flexible. A run was made of about two hours at eighty-five r.p.m. with all six cylinders firing and with practically no load—about the same conditions as with a propeller at such reduced speed. With three cylinders only in operation the speed was reduced to sixty r.p.m."

"The first fuel-consumption tests were made with the injections thirty-three degrees ahead of center. The engine used eighty-eight pounds of fuel per hour developing 200 b.h.p. at 300 r.p.m. which is 0.44 pounds per shaft h.p. hour. The indications are that this figure will be bettered when the engine is well run in and operating with steady load."

During the last hour of a three-hour run the average was 0.4325 pounds per b.h.p. hour. This the testers considered good enough, and so the injection was left at thirty-two degrees. The fuel used was locally obtained fuel-oil of 86½ S. G. at 65 deg. F. The engine was run developing 225 b.h.p. at 300 r.p.m. and the exhaust was nearly clear. There were some black puffs due apparently to the action of the automatic unloading valve on the water-brake. With full pump-stroke on all cylinders the engine at overload developed 315 b.h.p. at 300 r.p.m. at the exhaust.



The Price-Rathbun 200 h.p. marine oil-engine and its Kingsbury thrust-bearing.

From Steam to Diesel Power—The Conversion of the "Thrasher"

Recently we referred to the conversion from steam to Diesel power of the "Thrasher," a former steam-bark purchased by the Hibberd-Swenson Company, of Seattle, for their Siberian arctic trade from H. J. Knowles, of San Francisco, work on the conversion was well-advanced at the time of writing and the plant, a 300 shaft h.p McIntosh and Seymour Diesel engine, was expected to reach the Pacific coast from New York before the end of February.

The "Thrasher" was built in Maine in 1883 on the staunch lines that last. Despite the arduous service she experienced as a whaler for which she was originally designed and bucking the stiff gales of the Pacific her timbers are stil in splendid condition. Her frames are of live oak and her planking of Southern pine. The main dimensions are: Length, 144 ft.; breadth, 31 ft. 5 in.; depth, 16 ft. 4 in.

She will replace the "Belvedere," the famous arctic whaler and trader which was crushed in the ice off East Cape, South Siberia, on September 16 last year and was lost. The "Thrasher" has a cargo-capacity of 1,000 tons, or 200 tons more than the vessel which she will succeed. After a lengthy career as a whaler she was laid up in Oakland Creek until the shortage of tonnage caused by the wholesale sinkings by U-boats resulted in her being put into commission again. Her steam-plant was taken out and her rig altered to that of a three-masted barkentine. For two years she plied between San Francisco and Australia and New Zealand Modelled on finer lines than the majority of heavily-constructed vessels of her type she made some noteworthy runs 'cross Pacific, doing the voyage from the Golden Gate to Sidney in 38 days on one occasion, which is some ten days less than some wooden steamships did in the early days.

The barkentine rig not being suitable for the Arctic trade the "Thrasher' will be equipped for service as a three-masted top-sail schooner. New decking will be put in and a forecastle-head will be built. She will be sheathed for protection against the ice with two-inch iron-bar plates, also her stem will be heavily armored.

The auxiliary and emergency equipment is a noteworthy feature of the mechanical plant. An electrically-actuated windlass and winches are also provided. The former is being supplied by the Pacific Machine Shops and the latter by the Washington Iron Works of Seattle.

In order to secure the necessary compression in the event of a breakdown on the compressor of the main engine two separate units are being installed as part of the plant. One is a 25 h.p. Burnoil two-cylinder engine; the other a 16 h.p. Atlas Imperial gasolene-engine. Both will drive a Rix compressor of a capacity of 40 feet per minute to 1,000 lbs. These auxiliaries will have a joint capacity greater than the main-engine compressor, so contingencies are well looked after in this respect.

A Burnoil engine will be used to furnish power for a 15 k.w. generator for charging batteries and providing current for the lighting system, engine-room auxiliaries and the deck machinery. As a "stand-by" a 10 k.w. generator is provided. This will be directly connected with the Atlas gasolene engine.

For general purposes the circulating-pump will be operated off the main-engine by a link-belt, electrically-actuated. A Moran centrifugal circulating-pump is provided for use when docking or when other manoeuvres necessitate constant stopping and starting. The bilge and fire, and fuel transfer-pumps are also motor-driven. Battery capacity sufficient to immediately start the pumps is looked after. The battery set consists of 13-plate, Exide iron-clad cells of 110 volts.

The fuel capacity will be 34,000 gals. stored in ten tanks. This will provide a cruising radius of 13,000 miles, a long season's round trip with a reserve. The "Thrasher" is to be ready for service on April 1. L. E. Geary, naval architect of Seattle, is supervising the conversion of the craft and the installation of the new plant which is being put in by Edward Larson, the chief-engineer of the schooner, and his own crew. The re-building is being done by Olson and Sunde.

DIESEL-TANKER EARNS $1,000,000.00 MORE THAN SISTER STEAMER

According to Mr. E. A. Hedén, Engineering-Director of the Götaverken of Göteborg, Sweden, the two-cycle Polar-Diesel-engined tanker "Hamlet" earned about one million dollars ($1,000,000.00) more than her sister steamship up to the autumn of 1918 over the same period of time.

Mr. Hedén also stated, in a paper read before the Svenska Teknologforening, that the practical lessons taught by the performances of existing Swedish Diesel-driven cargo-ships is that freight between the East Indies and Europe costs exactly 50 per cent less to carry by motorship than by steamer. Also that the Diesel system of propulsion means longer life to a ship.

MR. WEBB MAKES AN ACKNOWLEDGMENT

It is the wish of Mr. A. C. Webb, well-known to many shipowners, representatives and brokers in the United States as an Export-Engineer, Marine-Surveyor and Inspecting-Engineer, and who is now connected with the Italian combine of shipbuilders, engineers and boiler-makers, etc., as their first Chief-Engineer at Savona, Italy, to thank the many representatives whom he has met personally in Italy for their testimony regarding in getting all their orders and instructions carried out in a satisfactory manner.

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THE DOUBLE-ACTING DIESEL MOTORSHIP "FRITZ," A SUGGESTION TO LORD PIRRIE!

The Glen Line (Gt. Britain) is the firm that has secured the Blohm & Voss-built double-acting Diesel-engined motorship "Fritz." In one sense this is unfortunate for the American industry, because the Glen Line hitherto has adopted strict secrecy regarding the operation of its motorship fleet, and the technical information concerning the machinery of this vessel would be of considerable value to American engineers. However, we trust that Lord Pirrie and other directors of the Glen Line will recognize the splendid way in which American engineers and shipbuilders came to the assistance of the allies during the war, and make all technical information concerning the "Fritz" available to them. We suggest our columns would form a suitable medium, also that the "Fritz" be sent on a voyage to New York, so that inspection will be possible.

RENDERING AN ACCOUNT OF THEIR STEWARDSHIP.

In an editorial leader in the New York "Times" for Monday, Feb. 16th, it is stated that **"The Shipping Board must be business-like. It will have to render an account of its stewardship. The Board cannot disregard and defy economic laws."**

The Shipping Board certainly will have to render an account of its stewardship as they have defied the economic laws.

In its own report the Shipping Board has admitted that the Diesel-driven vessel is the most economical type of cargo-carrier to-day. Yet the Board has built no such vessels.

AMERICAN SHIPOWNER STRONGLY URGES MOTORSHIP CONSTRUCTION

In a recent letter to the New York "Journal of Commerce" a well-known San Francisco shipowning and shipbuilding firm of Charles R. McCormack made the following statement, in which we think many other American shipowners will be interested:

"It is our firm belief that it is a very big mistake for the U. S. S. B. to be building so many steam-operated vessels, inasmuch as the Diesel has proven that when well built and operated it is a much more economical installation. Now, when things get normal again it will be a question of operating costs, as to who will command largest portion of the trade and the largest net profits. It will be noticed that Norway and other European countries are building a large number of Diesel-equipped ships, and when such large savings can be accomplished by the motorship as compared with the steamer it seems a mistake to build so many steamers."

"Could not the Shipping Board build at least half steam and half motor for the benefit of studying the operation of each type comparatively? America has the advantage of an unlimited supply of oil and steel as there are new fields being explored constantly, and we always have a great reserve supply in Mexico, of which we have heretofore neglected to avail ourselves. This gives us an advantage over almost all large countries who are competing for the world trade. We also have the advantage of location over other countries for the great Orient and South American trade."

* * *

"After Government shipbuilding ceases there should be a great deal of shipbuilding for private interests, as the realization will come to local capital of the mistake the Shipping Board are making by building so many steamers while Europe builds Diesel-equipped ships, and that a step is being taken in merchant ship propulsion and they will heed the call by building motorships. Already many shops have heard the call and are converting from building steam-engines to the building and perfection of the Diesel. The most economical way to burn oil in a ship is in the cylinders and not under the boiler."

THE DANISH MERCHANT FLEET

Denmark now owns 1,857 merchant ships comprising the following craft. These are the official figures up to January 1, 1919:

Motorships, 506, 89,711 gross tons; steamships, 542, 542,300 gross tons; sailing-vessels, 809, 109,938 gross tons; total, 1857 ships, 841,949 gross tons.

In addition there are in service 2,198 motorboats, corresponding to 18,088 gross tons.

It is significant to record that the number of Danish steamers has fallen from 706 to 542 since January 1, 1914, and their gross tonnage from 732,500 to 542,300 tons. On the other hand the number of Danish motorships has risen from 368 to 506 and the gross tonnage from 49,804 to 89,711 tons. When will American shipping people realize the sign that is on the wall?

THE SWEDISH MERCHANT FLEET

According to the latest official figures concerning the Swedish Mercantile Marine the following vessels are now in service:

Motorships, 421, 98,000 gross tons; steamships, 1,231, 882,000 gross tons; sailing vessels, 1,051, 116,000 gross tons. Total, 2,703 ships, 1,096,000 gross tons.

During 1919 35 motorships of 18,000 gross tons were built in Sweden and 10 motorships of 4,500 tons were purchased abroad, but only 32 steamships of 33,000 gross tons were constructed.

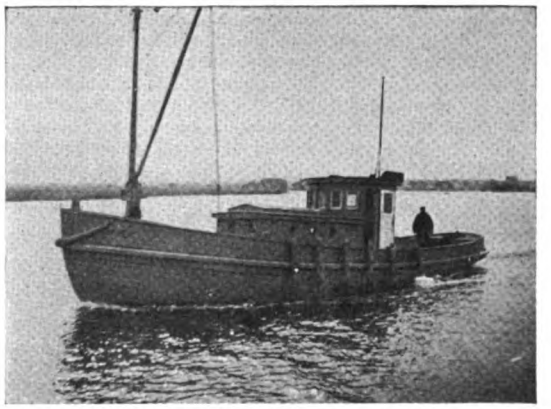
STANDARDIZED FRENCH MOTORSHIPS OF 4,500 TONS D.W.C.

In our issue of December last we announced that the well-known French engineering firm of Delaunay Belleville of St. Denis-sur-Seine, Paris, had acquired a Burmeister & Wain Diesel-engine license, and would construct the machinery for steel motorships to be built by their subsidiary shipyard, the Compagnie General de Material Navale, Bay of Pampin, near La Pallice. A later report states that these motorships will be built at La Rochelle.

The design of these vessels has been prepared in co-operation with the Danish firm. They will be standardized single-screw ships of 4,500 tons d.w.c. or somewhat larger in size than the eight single-screw, 1,500 shaft h.p. 3,500 tons d.w. sister motorships building by Schneider et Cie, of Paris, but will not be so fast. Their dimensions will be as follows:

Dead-weight capacity	4,500 tons
Length	304 ft. 0 in.
Breadth	44 ft. 3 in.
Depth	30 ft. 6 in.
Draught	21 ft. 6 in.
Capacity of holds (bales)	230,000 cu. ft.
Capacity of holds (grain)	247,000 cu. ft.
Ratio of machinery installation to hold capacity	13.1%
Power	1,400 i.h.p.
Bunker capacity	600 tons
Cruising radius	25,000 nau. miles

The main engine is a six-cylinder four-cycle Diesel type unit of 1,400 i.h.p., with Diesel-electric auxiliaries, there being eight 3-ton winches, and an electric-hydraulic steering-gear. The oil-fuel is carried in the double-bottoms, and there also is 200 tons of ballast water in the peak. Each ship will be built to the Bureau Veritas class, div. D/SL. 11 awn. deck, which registration society, has been devoting particular attention to motorships of late.



The motor-tug "Hamer."

TUG-BOAT WITH ONE-MAN CONTROL

An interesting little motor-tug is owned by W. H. Gahagan, Inc., of Brooklyn, N. Y. We refer to the "Hamer," a 51-footer fitted with a 100 b.h.p. Fairbanks-Morse surface-ignition oil-engine. The special feature of this craft is that all engine-controls are carried to the wheel-house and are operated by the navigator, who has a view of the engine through the sky-light over the engine-room.

In a letter to "Motorship" her owners say that the engine runs so smoothly that the Captain has never had occasion to worry about whether he could see it or not. This certainly is a compliment to the engine-builders. He has both air and hand control over the reversing mechanism, an air-valve similar to a locomotive air-brake valve throws the clutch in and out so that the operator does not have to let go of the steering wheel.

The "Hamer" was designed by Mr. Chas. A. Tonsor, Jr., Chief-engineer of the W. H. Gahagan, Inc., for the rough waters often met off Rockaway Inlet and Coney Island; she was built at the company's Arverne shipyard. She is 51 feet 2 inches long by 16 feet 6 inches breadth and draws 5 feet of water. She has towed loads considerably over those for which she was designed. Recently she towed the company's "Dredge 2" with derrick scow and 40 pontoons carrying pipe lines from Gravesend Bay, across the Bar to Jamaica Bay—a job for which two steam-tugs were previously required. Then she towed the same dredge and equipment and a scow with 273 tons of coal aboard.

THE "EMANUEL NOBEL"

In our issue of February, 1920, on page 129, we referred to the case of the "Emanuel Nobel" and that she had not been in service six months with steam-machinery before the owners desired to reinstall the original Diesel-engines; but that the American Company who carried out the conversion work would not sell to the original owners for less than three times the original cost.

In this connection we have had a communication from the latter to the effect that our statement is without foundation and that the owners would like to dispose of these engines, and that the American firm in question have been trying to sell them for them.

However, some time ago we took up the question of purchasing these engines on behalf of the U. S. Shipping Board, Emergency Fleet Corporation with these American builders and the price asked was about three times the original cost. Furthermore, about that time we received a cable from Europe requesting us to obtain a quotation on these engines, and were advised that the quotations were desired by the original owners, who wanted to replace the engines in the old ship.

AGENCY FOR AMERICAN PRODUCTS REQUIRED IN ENGLAND

American firms who desire an agent in Great Britain should communicate with Mr. F. L. Robinson, Ex-Capt. R.H.A. & R.A.F., Coronation House, 10 Marine Parade North, Great Yarmouth, England. Mr. Robinson is an engineer and can furnish bankers' references, but through being invalided from the British army, was unable to follow his profession as an engineer. Under certain conditions he is quite prepared to come to the United States to make the necessary arrangements, should a visit be desirable.

GRANGESBERG CO. INCREASE MOTORSHIPS ON ORDER TO SIX IN SWEDEN AND SIX IN DENMARK

In our issue of November we stated that a fleet of 18 ships of 7,500 tons d.w.c. had been ordered by the Trafikatiebolaget Grangesberg-Oxelosund of Stockholm, from the Götaverken, and that two of them, or more, would be Diesel motorships. We understand that it is definite that six of the vessels will be motor-driven, and will be of 8,000 tons d.w.c. each instead, as well as six ships on order with Burmeister & Wain of Copenhagen, Denmark. Furthermore, it is likely that 16 out of the 18 Götaverken boats will be Diesel-driven. When the fleet is completed, this will give the Grangesberg Co. 22 motorships aggregating 176,000 tons d.w.c. and 57,200 i.h.p. But we presume that it will take several years to complete this great fleet.

Since we were at the Gotaverken Plant it seems that the dimensions of these ships have been slightly changed as they now are:

Dead-weight capacity	8,000 tons
Length O. A.	400 ft. 0 in.
Length B. P.	387 ft. 1 in.
Breadth	54 ft. 0 in.
Depth to shelter deck	34 ft. 6 in.
Loaded draught	24 ft. 3 in.
Fuel capacity (bunkers)	500 tons
Balast tanks (fore and aft peak)	1,800 tons
Position of machinery	Midships
Power of main engines	2,600 i.h.p.

In view of the big Diesel-driven ore-carrier now completing by the Bethlehem Shipbuilding Co., the following table prepared by the designers of the Swedish ore-carriers, Messrs. Johnsson & Pettersen, naval architects, Goteborg, may be of interest:

	Form.	Ore-carrier, 8,000 tons dw. Steamer.	Motor-ship.
Bending Moment and Normal Tension:			
Bending moment 'midships	Ft.×ton	121,000	93,500
Pulling strain	Tons per sq. in.	7.0	5.4
Pressure strain on keel	" "	4.9	3.8
Breaking Strain and Tangential Stress:			
Greater breaking strain aft	Ton	1,560	1,170
Greater breaking strain for.	"	18,668	1,020
Shearing strain aft	Tons per sq. in.	4.6	3.5
Shearing strain forward	" "	5.4	4.1

There will be three holds forward of the engine-room and two abaft with the bunkers between the after holds and the machinery space The bridge will be well forward, over the bulk-head separating hold 2 from hold 3.

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Reversing Mechanism For Surface-Ignition Oil-Engines

Details of the New Gulowsen-Grei Design and Its Adaption to Both Small and Large Motors

UP to the present time it has been customary not to make low-powered marine oil-engines direct-reversible but to reverse the propeller by means of a mechanical reverse-gear fitted between the tail-shaft and the engine, or else by means of a reversing-propeller, although the latter method is not very popular in this country due to reversible-propellers of small motorboats having been poorly and cheaply constructed in the early days of the industry. As yet the prejudice against the reversing-propeller has not been swept away, although there are some excellent models on the market, the use of which in the case of fishing-boats often is very desirable.

In Scandinavia the reversing-propeller is very popular among owners of small fishing-craft, but

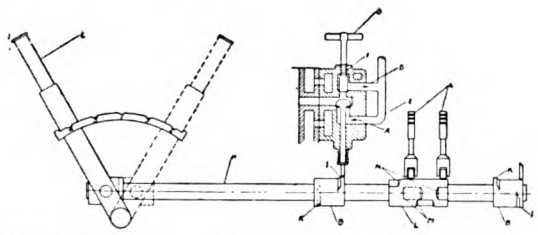

Fig. 1. Diagrammatic sketch showing starting and reversing mechanism of "GG" Engines.

when the Gulowsen-Grei Engine Co., of Christiania, opened up a large factory at Seattle, Washington, they realized the difference in feeling in the two countries, and set to work on further developing the direct-reversing mechanism used with their larger surface-ignition type marine heavy-oil engines. They succeeded in producing a model that can be successfully used with engines as low as 30 b.h.p. in two cylinders, as well as with four-cylinder motors of 240 b.h.p. This has been adopted as standard, without interfering with the simplicity and reliability of the engines, and greatly improves their maneuvering capabilities. Incidentally it increases the efficiency of the engine as there is no longer any loss of power in transmission through the reversing mechanism, either in the ahead or astern positions. So a better engine all-round is the result.

A brief description of the general characteristic features of the "GG" oil-engine will make the explanation of the reversing and starting system more easily understood. In the following the two-cylinder model is considered, but the four-cylinder engine is not essentially different as only additional fuel-pumps and air-valves are required on the extra cylinders.

Mounted on the bed-plate just astern of the after cylinder on any size engine is a gear-case in which are three spur-gears always in mesh, one directly on the crank-shaft, one acting as an intermediate, and one keyed to and turning the cam-shaft at the same speed as the crank-shaft. From the intermediate gear practically all of the auxiliaries are driven, namely the governor and small electric generator by means of bevel-gears on the intermediate shaft, circulating-water and bilge pumps and also fuel-service pumps by means of crank-pins mounted on the ends of the shaft. The lubricators are driven by similar means. These are all turned at a suitable speed, and are mounted on the gear-case to present a very compact and neat appearance.

With these auxiliary devices well taken care of, there remain only the fuel-pumps and the air-starting and reversing systems to be operated by means of the cam-shaft. This shaft runs along the front of the engine on a level with the bottom of the cylinders, and on it opposite each cylinder are the cams for operating the air-valves, while between the cylinders are the fuel-pump cams. The lever for operating the sliding cam-shaft is bracketed on the gear-case and by the use of this starting and reversing is accomplished as now will be explained.

This arrangement is most convenient as it follows the best standards of oil-engine design, places all important working parts in accessible positions and provides for simpler and better operation. The position and method of driving the fuel-pump is illustrative of this first point; as the pumps have the same relative positions with respect to each cylinder, and the stroke of the fuel-pumps are not affected in any way by wear as is the case with pumps driven directly from the crank-shaft. Furthermore, these pumps are accessible and, in fact, the pumps operating lever and governor are so placed that they are all within reach of the operator at the same time. The governor works directly on the stroke of the fuel-pump in regulating speed.

The operation of the starting and reversing features can best be described by referring to Figure 1, which is a diagrammatic illustration of the standard reversing-mechanism of two-cylinder engine. "H" represents the cam-shaft which is driven through gears from the crank-shaft and at the same speed as this. When the lever "C" is in position "1," the engine cannot be run, and if shifted into this position from either one of the running positions, the engine will stop at once. In positon "1" the roller operating the valve "A" runs in the middle of cam "B," and as the projections or cams "K" and "I" are on the ends, the valve "A" will remain closed and no air will be admitted from the air-tanks, no matter the position of the crank. It will also be noted that in this position the rollers operating the injection-pumps "O" run between the cams "N" and "M" and that these pumps are, therefore, not operated and no fuel is admitted to the combustion-chambers..

When it is desired to go ahead, the lever "C" is thrown to position "2". The cam "K" matches with the valve-stem "A" and air is admitted to the cylinder at the proper time, causing the engine to go ahead. The cam is so adjusted that no air is admitted after the piston reaches the exhaust-port.

At the same time as air is being admitted thru valves "A," one set of cams "M" and "N' operate the injection-pumps "O". The lever "C" is only held in position "2" for a period of two to four seconds, at the end of which it is shifted back to position "3" which is the running position "ahead." Combustion in the cylinders usually commences after the first couple of revolutions of the engine. To go from "ahead" to "astern" the lever "C" is shifted to position "1," held there until the engine has almost come to a standstill, then thrown into position "4", held there from two to four seconds and then thrown into position "astern 5" just as "3" is running position for "ahead." The fuel-pump cams "M" and "N" are, of course, wider than the air-cams "K" and "I", so that they act on the fuel-pumps in position "5" and "3," when the air cams are not in action, as well as 4 and 2 when the air-cams are in action.

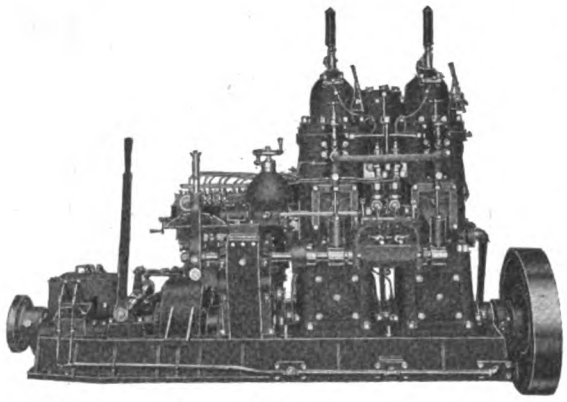

Fig. 3. Gulowsen-Grei two-cylinder 45 h.p. direct-reversing heavy-oil marine engine.

It has been found by test and also in actual operation that by following these simply instructions that reversing has been accomplished a great number of successive times without a single failure. As long as there is sufficient air-pressure to turn the engine over and as long as the reversing-air is admitted before the engine comes absolutely to rest, it works with perfect satisfaction.

The air-pressure for reversing and starting is built up by the engine itself through the charging check-valve "F" at any time during the operation of the engine. When the handle "G" is opened this valve acts as a discharge valve in an air-compressor and allows the tank to be charged directly from the engine cylinders. The valve should be opened after engine has been started to refill tanks to a maximum and also when maneuvering to maintain this pressure.

The result of a test on a twin-cylinder 45 h.p. at 380 r. p. m. "GG" engine under full load is indicated by the curve in figure "2." The object of this test was to determine the number of complete reversals which could be made per minute continuously without losing air-pressure from the tank.

The curve shows the air-pressure maintained in a tank of 12 cu. ft. capacity through the charging valve "F" while the engine was being reversed at the rate of one full reversal every fifteen seconds, or four per minute covering a period of fif-

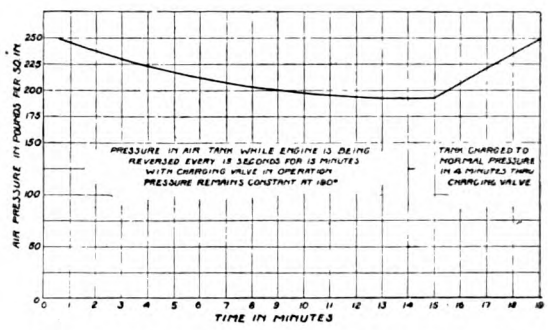
AIR PRESSURE IN POUNDS PER SQ. IN.
250
225
200
175
150
100
50
0
PRESSURE IN AIR TANK WHILE ENGINE IS BEING REVERSED EVERY 15 SECONDS FOR 15 MINUTES WITH CHARGING VALVE IN OPERATION PRESSURE REMAINS CONSTANT AT 190#
TANK CHARGED TO NORMAL PRESSURE IN 4 MINUTES THRU CHARGING VALVE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
TIME IN MINUTES

Fig. 2. Curve indicating air-pressure in starting tank while the engine is being reversed at the rate of 60 complete reversals in 15 minutes.

teen minutes. The test was carried on for a much greater length of time but the pressure showed no tendency of dropping below 190 pounds. This is a very severe test and shows a much better performance than should ever be required under actual operating conditions. The curve also shows the short period of time required in building up the tank to normal pressure while not using the air.

SCOTTS TO BUILD 2,400 B.H.P. STILL ENGINE

Should the experimental Still combination Diesel-steam oil-engine built by Scotts Shipbuilding & Engineering Company, of Greenock, Scotland, prove successful, they will construct a six-cylinder 2,400 shaft h.p. marine set, and a fuel-consumption of about 0.30 lb. per shaft h.p. hour is expected. The experimental engine, which they built under Still-Ackland license, is a single-cylinder 22 in. by 36 in. model developing 400 i.h.p. at 120 R. P. M.

CONTRACT FOR OIL BARGES

A contract to build and equip three steel single-screw motor-barges, of 500 tons capacity each, for the carriage of oil fuel in bulk has been received by J. Samuel White & Co. of England. These vessels will be of the single-deck type, with upright stem and elliptical stern, and are to have one mast and derrick and a hand-winch each. The machinery is to be placed aft and will consist of a two-cycle Kromhout oil-engine and accessories: Two pumps will be provided for the cargo, each with a capacity of 100 tons per hour. The oil will be carried in three cargo tanks divided by a longitudinal bulkhead into six oil-tight compartments, and the vessels will be built under special survey to class 100 A-1 at Lloyd's for river and harbor service. Accommodation for five men will be provided in two rooms in the forward part of each vessel, with cooking range and food lockers.

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Another Diesel Electric Installation

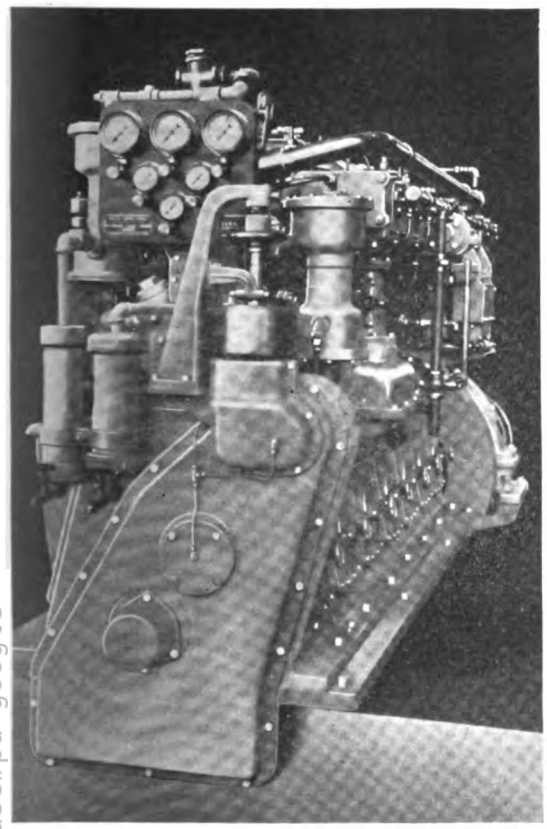
Details of the Winton-Westinghouse Propelling Plant in the "Elfay"

LATELY the Diesel-electric drive has been the subject of quite a little discussion as it seems to offer the only sensible means of furnishing economical propelling-power for the Government's otherwise almost useless wooden vessels. Also it offers many advantages for the propulsion of fishing-vessels, if one may judge by several craft so equipped which are now operating on the East Coast of America.

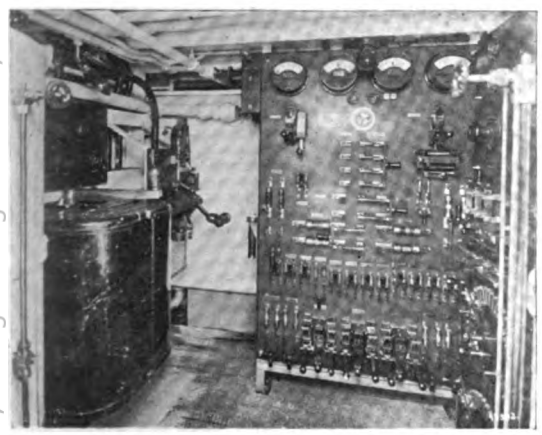
Of course, much has yet to be learned and demonstrated before it will be extensively adopted for large high-powered merchant-vessels, particularly from the point of view of fuel-economy compared with the direct Diesel-drive.

But, there can be no dispute that it offers many attractions and so unless it is found "wanting" it will find favor in the eyes of many ship and fishing-vessel owners, especially for tug-boat and ferry-boat installations, and wooden ships for which it seems ideally suited.

We have before us details of an interesting installation of Diesel-electric-power recently carried out by the Winton Engine Works of Cleveland, Ohio, in conjunction with the Westinghouse Electric & Mfg. Co., of East Pittsburgh, Pa. As it happens this equipment is installed in the 313 tons-gross yacht "Elfay" owned by Mr. R. A. Alger; but, as dealing with pleasure vessels is outside the scope of "Motorship" we propose to have nothing to say about the vessel herself.



Forward end of Winton-Diesel-engine. The after end is coupled to a Westinghouse generator.



The switchboard in the engine-room.

However, as the Winton Diesel engine and the Westinghouse electrical machinery is similar to that which would be installed in small merchant ships we describe and illustrate the same, also because it incorporates many features of interest to the designers, builders, and owners of commercial vessels, and which as yet cannot be found in existing cargo boats.

Mr. Alexander Winton and his engineers were given practically *carte-blanche* to work out a complete Diesel-electric drive for the "Elfay," and as the result of the plans drawn up and the details worked out, the installation now consists of the following: A six-cylinder Winton-Diesel oil-engine, bore 7½ inch, stroke 11 inch and rated at 115 H.P. was installed, direct-connected to a 75 K.W. Westinghouse generator, which in turn was direct-connected to a 9 K.W. Westinghouse exciter. Credit must be extended to the Westinghouse engineers for the very complete and efficient manner in which their part of the installation was carried out.

The entire ship is operated and controlled by electricity, no steam whatever is used or is required, and it is an education in itself to go aboard and find every last little accessory and equipment operated by electricity.

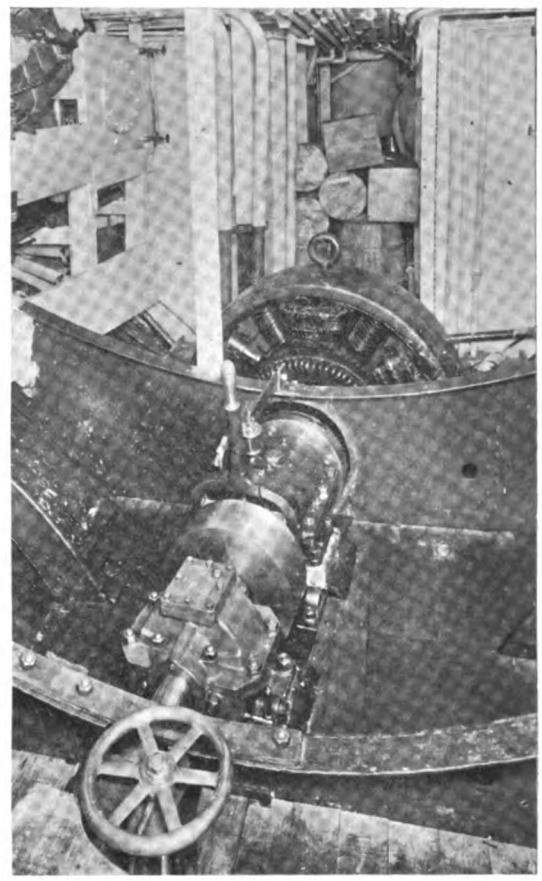
The windlass forward, used for handling the anchor and in case of necessity for handling the sails, is electrically operated and is driven by a 10 H.P. electric-motor. Amidship two electric-winches of 4 H.P. each are used for hoisting and lowering the sails. The boat throughout is heated by electricity, lighted by electricity, and all cabins, etc., are supplied with electric-fans, while a ½ K.W. wireless set is installed aft. Down in the engine room everything is operated electrically. There is a one-ton ice-machine operated by a 7½ H.P., electric-motor; a water-pump, a bilge-pump, an oil-pump, and a ¾ H.P. airpump, supplying fuel to the oil-range in the galley, all electrically driven, also an electrically-operated grinder and drill for necessary repair work. All bilges are kept ventilated by electrically-operated motors. The engine-room itself is ventilated by a 1 H.P. electrically-operated fan. Furthermore the Winton air-compressor in the engine-room is operated by a 12½ electric motor.

In addition to the main generating-plant there is an auxiliary generating-set consisting of a 25 H.P. Quayle-Hvid oil-engine connected to a 15 K.W. generator. This is purely an auxiliary outfit used to a charge set of Philadelphia storage-batteries when the boat is lying at dock for any length of time.

The installation of the storage-batteries is a very elaborate and complete one, and gives a rated capacity of 60 amperes-an-hour for five continuous hours and all requirements of the boat outside of the actual propulsion through the water are supplied by this battery for two complete days without recharging.

At this point in the article it may be of value to give an extract from a report made to the owner by J. S. Walters, the chief-engineer of the ship.

"The engine is direct-connected to a 75 K.W. generator and also drives a 9 K. W. exciter by



View of the 90 h.p. electric driving motor and thrust block.

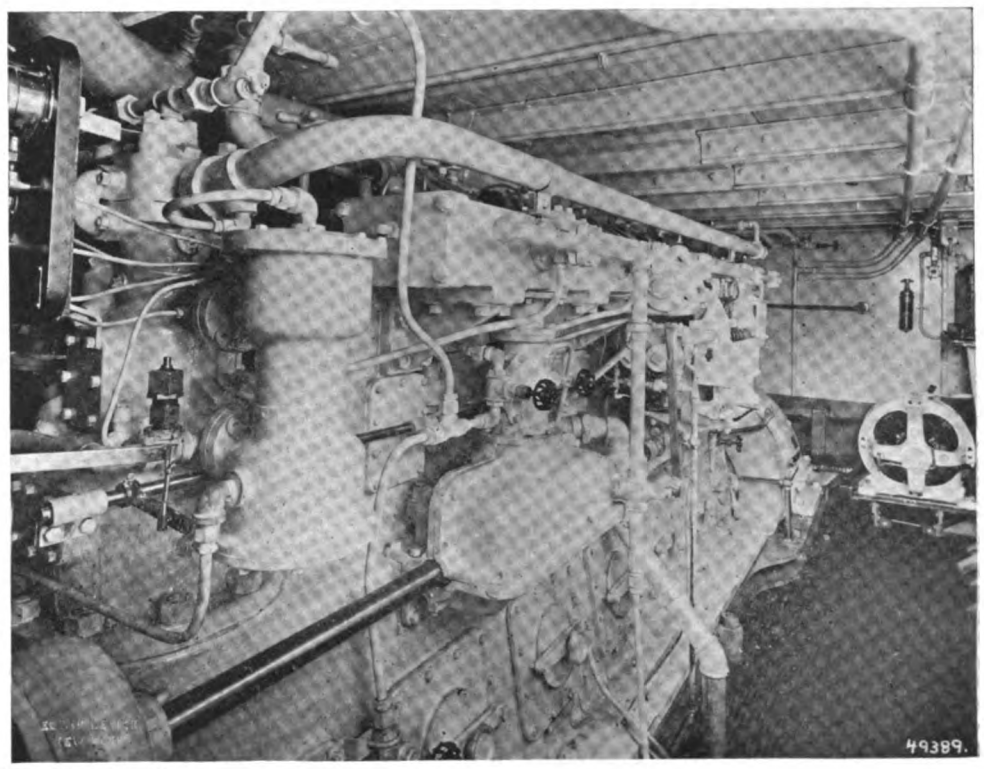


Photo Edwin Levick

Engine-room of the "Elfay." It is finished in white paint. On the right can be seen the chain-driven exciter.

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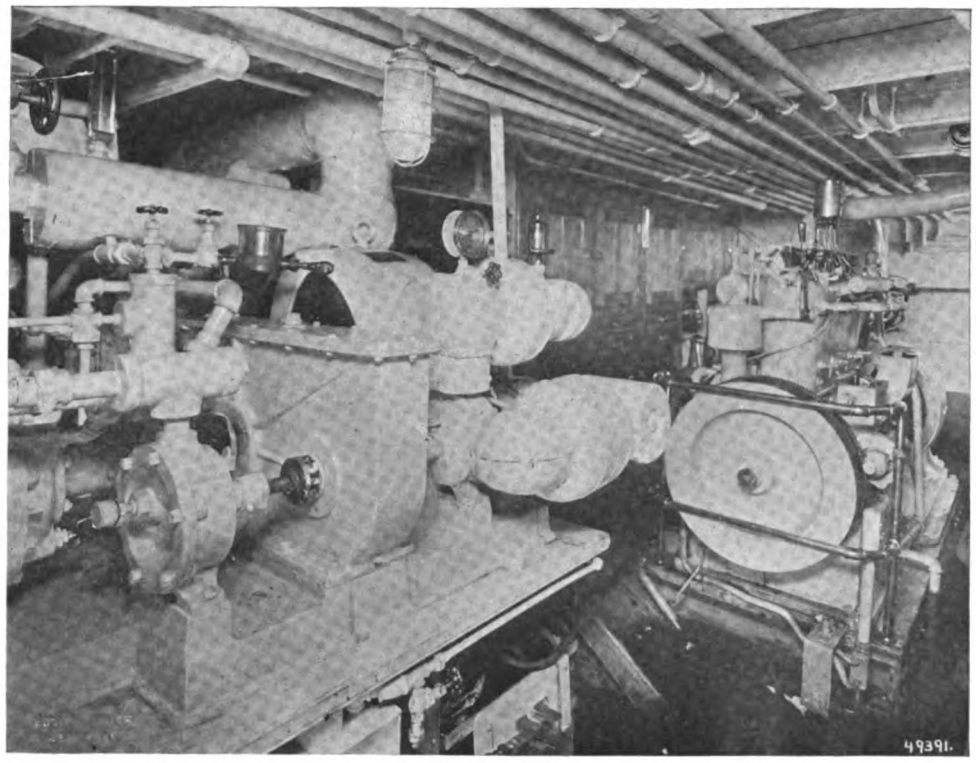

The one-ton capacity electrically-driven ice-machine. In the background can be seen the Quale-Arid auxiliary oil-engine.

Control station of the "Elfay." The handle on the pedestal gives the navigator complete control of the maneuvering of the ship, without signaling below.

means of a noiseless chain. The exciter turns at 900 R.P.M. The motor and generators are both separately excited from the exciter. The motor carrying a full field at all times and the generator field is strengthened as you go either ahead or astern from on deck, by means of a controller, which is connected to a Rheostat below deck.

"In the stop position you have no field in the generator but a full field in the motor; in the full-ahead position you have a full field in both, and likewise a full field in both in the full-astern position. Your speed ahead or astern is varied according to the strength of the field in the generator.

"The exciter has a capacity of 9 K.W. and the motor requires about ½ K.W., and the generator 2 K.W. for excitation, having 5 K.W. for auxiliary purposes, such as lights and power.

"The main electric motor is installed as far aft as possible, giving a very short shaft. It is 90 H.P. at 360 R.P.M., turning a 42 in. x 42 in. three blade propeller, giving between 8 and 8½ knots per hour.

"The control is very simple and very efficient, enabling you to go from full-ahead to full-astern or vice-versa in five seconds. It is simple inasmuch as you do not handle your main current but a small portion of your exciter current.

"The actual operation consists of starting the engine idle, next throw the cam-controller switch, building up the motor field from the exciter. Then the main-breaker between the cam-controller and motor. These are the only connections the engineer makes. The rest is controlled from deck. The deck-controller is a small brass stand about 30 in. high. The handle has a swing of about 20 in. By moving the handle one-half of the circle you get full-ahead, move it the opposite way one-half the circle you get full-astern.

"A metering-panel set in the deck-house gives you the voltage of generator, motor and exciter. The amperes used, also the R.P.M. of the motor and generator. A duplicate set gives you the information in the engine-room. It also tells you if you are going ahead or astern.

"The officer on deck knows at all times what speed he is making and can get the exact speed or power he wants either ahead or astern when he is in a tight place. He not only has control of the ship but the control of the power aboard also."

It will be noted that the officer on deck is in complete control of the power unit. He does not have to rely on signals to the engine-room. In addition he has as much power available for reversing as he has for going ahead and all within the uncannily short period of five seconds.

Here is an installation of a Diesel-engine using fuel-oil—the cheapest fuel obtainable—supplying that most flexible of all propulsive powers, electricity. Here is a compact, quiet and clean power plant. Such an installation can be operated at a minimum of expense for either fuel or labor as compared with any type of steam power installation which could have been made. The fueling situation is very efficient. The boat has a capacity of 2400 gallons of fuel-oil, which gives her a radius of 2000 cruising miles with a consumption of approximately 7½ gallons per hour. In addition 360 gallons of lubricating-oil are carried.

It is interesting to note that efficient as this type of installation should be in such a boat as the "Elfay" it could be made even more desirable as an installation in our wooden cargo-carriers, where economy of operation is so vitally necessary. In fact, it is a none too well guarded secret that a number of cargo-boats built by the Emergency Fleet Corporation in the hurry-scurry of war requirements are being converted from uneconomical and unprofitable steamers to economical and highly-profitable Diesel electrically-driven boats, using the same principle of installation as just described.

However, it would add to the interest and value if the information of the fuel-consumption per propeller-shaft h.p. were given, as with higher powered vessels this will be very important.

GERMAN DIESEL ENGINE TECHNICAL PAPER

At the meeting of the Schiffbautechnische Gesellschaft held at Berlin, from November 20 to 22 last, a paper on the "Problems of the Oil-engine and Its Development at the Germania Yard at Kiel-Gaarden," was read by Herr Oberingenieur Alt.

MOTORSHIP FLEET OF THE GLEN LINE

American Steamships Cannot Carry American Products From the U. S. A. to Other Countries in Competition with These Economical Vessels. Shipowners of the United States, Awake to Your Future Business!

As we have previously mentioned, one of the most progressive shipowning companies in the United Kingdom is the Glen Line, Ltd., who already have a large fleet of Burmeister & Wain-Harland & Wolff Diesel-engined motorships in service and many additional vessels on order, including a number of 13,000 tons d.w.c. and 14 knots loaded sea-speed. The vessels already launched are as follows:

	Gross Tonnage
"Glenade"	6200 tons
"Glenamoy"	7269 "
"Glenapp"	7374 "
"Glenariffe"	6200 "
"Glengyle"	6225 "
"Glenary"	5075 "
"Glenuce"	6800 "
"Glentara"	6800 "

It will be seen that each vessel is of about 10,000 tons d.w.c. or over. The powers of these vessels run from 3100 i.h.p. to 6600 i.h.p., so when the remaining motorships are completed, the Glen Line will have a splendid fleet of economical freighters. It is most fortunate for America that these vessels are mostly engaged in the England-Far East trading route, so our uneconomical steamers will not frequently come in competition with them, although, of course, this is bound to occur from time to time.

LIGHT-LOAD RUNNING OF SURFACE-IGNITION MARINE OIL-ENGINES

In the past, difficulties have been met with surface-ignition type heavy-oil engines in connection with running on light loads. The trouble has arisen through the fact that on light load the engine consumes an extremely small quantity of fuel and the heat produced is inadequate to vaporize the fuel-oil for the succeeding injections and to give complete combustion.

During the last few years Viskers-Petters, Ltd., of England, in the course of their research work in connection with oil-engines have kept this problem well to the front and now advise us that they have achieved a thoroughly satisfactory solution which completely eliminates all troubles of this kind, and in addition enables the engine to run at slow speed with perfect combustion and regularity of ignition with their means are provided for giving a supplemental injection, which is forced into the combustion-chamber earlier than the normal injection.

The earlier injection is effected by giving an extra stroke to the fuel-pump on the single-cylinder engines, and on the multi-cylinder engines a device is fitted whereby one fuel-pump may be made to deliver fuel to two cylinders at each stroke one portion of the charge being injected into the cylinder normally supplied and at the correct timing and the other portion is injected in advance of the normal timing. In this way each cylinder is supplied with an advanced injection. The earlier injection of the light charges gives more time for the vaporization of the fuel-oil and maintains sufficient heat in the combustion chamber to produce perfect combustion.

This means that the engine will continue to run at no load firing regularly without the aid of the starting-lamp and the engine also can run at slow speed with the same result. The device is operated by hand instantaneously.

SUGGESTION TO AMERICAN OIL-ENGINE MANUFACTURERS.

The names and addresses of an unusually large number of motorship owners in the United States and foreign countries appeared in the January, 1920, issue of "Motorship." We suggest that every American marine oil-engine manufacturer sends one of his catalogues, together with a letter to each of these firms.

SHIPS HELD ABROAD BY LACK OF COAL

So reads a headline in a recent issue of the N. Y. "Journal of Commerce," referring to American ships in foreign harbors held-up by lack of coal a month and over, of which there were said to be between 20 and 30 vessels then awaiting coal in London and Liverpool, the price of which fuel was 125 shillings per ton.

This is one of the factors that bring out the importance of motorships to the U. S. A. as they can cruise around the world on the small supply of bunker-oil taken aboard at the starting point in America, and so are quite independent upon foreign supplies, without encroaching upon their cargo space. Also they can sell part of their bunker oil to less fortunate steamers in distant ports where oil is scarce.

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Framing of Diesel-Type Marine Engines

A Discussion of the Various Designs

By "DRAWING BOARD"

STIFFNESS of a Diesel-engine, like any other marine engine, depends entirely on the construction adopted for the bed-plate, column and cylinders; yet in spite of this, the design of these parts is a subject often ignored or only superficially dealt with in Diesel-engine text-books. This is all the more surprising when we remember that this subject is usually dealt with at length in steam-engine text-books.

True it is that few calculations are really necessary, but it is interesting to note the differences in design, and the reasons why such a variety of designs exist, for it is obvious that the experiences of the various makers must have produced sound reasons which led to the development of these different designs.

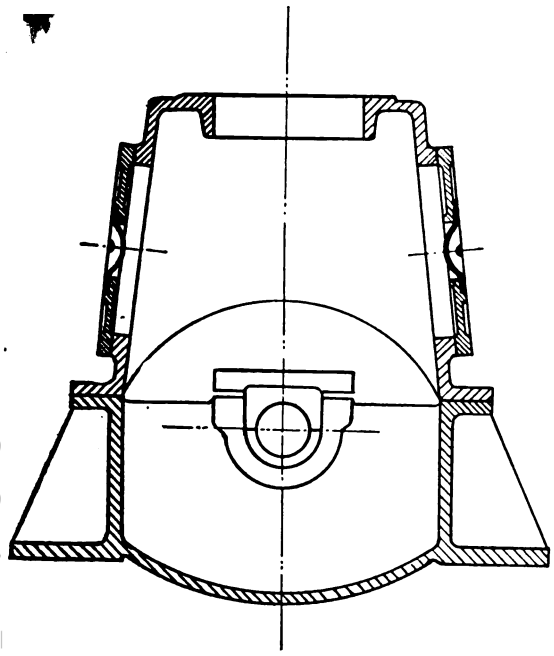

Fig. 1.

Now, what are the functions of the various portions of the engine-framing; firstly, the bed-plate forms the foundation of the engine, it serves to carry the columns, and provides the main-bearing structure for the support of the crank-shaft. It also forms a sump for the collection of waste lubricating-oil.

The columns, or framing, serve to support the cylinder, to carry the side thrust of the cross-head due to the angularity of the connecting-rod, to provide stiffness and rigidity to the engine structure as a whole, and in some cases to take up the tension-stresses between the cylinder and the bed-plate, due to the pressure in the cylinder. In some designs an iron, steel or bronze casting called the entablature is fitted on top of the columns, which then supports the cylinders, and further strengthens the framing. There are certain minor uses to which these parts are put, but these will be mentioned later.

To adopt a broad classification, there are two distinct types of Diesel-engines, viz., high-speed trunk-piston engines and low-speed cross-head type of engines with short or long pistons. Nearly all submarine engines for instance fall into the former type, and as these engines are fitted with forced-lubrication, the crank-case is totally enclosed, framing taking the place of columns, while the side-thrust is carried by the cylinder-liner jacket and through these by the framing.

The second type is usually fitted in Diesel-driven merchant motorships and follows more or less on the lines of marine steam-engine construction having long columns, two or more per cylinder. These columns may either be cast, or made of forgings, and are provided with cast-iron guide faces for the cross-head slippers. In this case the side-thrust is taken up by the columns direct without it having to pass through the cylinder-liner and jacket.

A typical construction of a bed-plate and framing for a high-speed engine is shown in Fig 1. As this type of engine is usually installed when weight and space are points of paramount importance, it is necessary to reduce all dimensions to their minimum safe limits, to reduce all clearances, and to suffer sundry minor inconveniences in order to effect this saving. The bed-plate shown in this illustration is therefore cast with a partially circular section sufficiently large enough to allow a neat clearance for the connecting-rod end, as it rotates with the crank. Two side flanges stiffened with vertical ribs provide the seating for the bed-plate in the ship, and a seating for the framing on the bed-plate. This section continues the whole length of the engine, while at various points transverse-girders are cast, to carry its main-bearings. The framing is a box-shaped casting strengthened by numerous ribs, and bolted direct to the bed-plate. Holes are cast and machined in the upper surface, and into these the lower ends of the cylinder-jackets are spigoted and bolted onto a facing provided. Large holes are cast back and front and covered with doors,—fitted to ascertain whether the bearings are running warm or not. As mentioned above this is a standard design for this type of engine, and it will serve for considering the design of the various parts.

The dimensions of the bed-plate are usually such that the stresses on it are negligible, for instance in Figure 2 in which "W" represents the total downward load on the crank-pins due to cylinder pressures, weight or parts, inertia, etc. The load creates a bending moment on the main-bearing girder acting about the supports "AA" and consequently the maximum stress occurs at "X," i. e. where the bearing-girder is naturally of a very deep section. This light stress is made even smaller, when through bolts are employed as will be dealt with later, and is removed altogether if shocks are fitted under the center of the bearing-frame, as indicated by the dotted lines. The well of the bed-plate is utilized as a sump for the collection of excess lubricating-oil, and provision must be made in the transverse bearing-frames to allow the oil to pass along to the drain outlet, from whence it passes to strainers and coolers and is then ready for use. Again in some engines when weight is an essential, the bottom of the crankpit or well is cast open and covered by a light steel plating securely held in place.

The main-bearing must be large enough to keep the bearing-pressure within reasonable limits. Table "I" gives the actual bearing-pressures of various four-cycle high-speed engines, all fitted with forced-lubrication. It will be noted that two pressures are given in each case, i. e., starting and full-load pressures. This is because of the high working-pressure of the starting-air, which creates higher pressures than these occasioned in ordinary running; the inertia of the parts also has an effect on these loads.

To obtain the pressure on the bearings it is necessary to take into account the pressure in the cylinder, the inertia-loads of reciprocating parts, the centrifugal-load of revolving parts, and the dead-weight of the parts acting on the bearings. And, as each bearing is acted on by two cylinders, it is necessary to determine the pressure on the bearing from both cylinders at the same time, and to find the net resultant pressure on the bearing. Where two bearings are fitted between

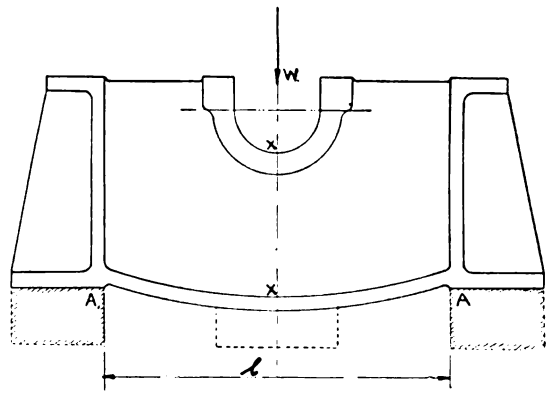

Fig. 2.

the cylinder only one set of pressures need be considered. All these different loads should be plotted on squared paper, the cylinder-pressures being sealed off a hypothetical diagram for equal divisions of the crank revolution. The inertia and centrifugal forces are dealt with by the well known formulae, while the weight of parts when once calculated become a straight line on the diagram.

(*To be continued in our April issue*)

TABLE I.

BEARING PRESSURES — HIGH SPEED ENGINES.

B.H.P	No of Cyls	Cylinder Dia	Stroke in Inches	R.P.M	Cycle	Main Bearings			Crank Pin		
						Area	Pressure lbs/in² Starting	Pressure lbs/in² Full Load	Area	Pressure lbs/in² Starting	Pressure lbs/in² Full Load
800	8	14·5	15	380	4	90·5	990	770	45·2	1940	1440
350	8	10·75	13	450	4	55	810	516	26·3	1715	1045
1850	12	17	19	340	4	146	775	610	65	1740	1365
800	6	13·9	15	360	2	105	770	-	56	1300	-

TABLE II

BEARING PRESSURES — SLOW SPEED ENGINES

BHP	No Of Cyls	Cylinder Dia	Stroke Inches	RPM	Cycle	Main Bearings			Crank Pin		
						Area	Pressure lbs/in² Starting	Pressure lbs/in² Full Load	Area	Pressure lbs/in² Starting	Pressure lbs/in² Full Load
750	8	17	-	150	4	184	615	520	92	1230	1050
1250	8	20·75	-	140	4	284	600	463	142	1700	926
-	-	32·2	-	130	2	880	463	-	361	1165	-

FUEL THE BIGGEST ITEM OF OPERATION, SAYS B. S. GROSSCUP, ATTORNEY FOR THE PACIFIC STEAMSHIP COMPANY

During the recent hearings before the Senate Committee on Commerce, the following interesting statement was made by Mr. B. F. Grosscup, attorney for the Pacific Steamship Company—"Your Labor cost is vastly different (referring to the operation of Oriental and American steamers), but you take the great big item of fuel or coal—we out there use oil—they cost the same. Now that is the biggest item of operation! Sustenance makes very little difference, except one eats less than the other."

Taking Mr. Grosscup at his own words we ask him point-blank if the fuel-costs of American ships were reduced by 75 per cent (as they would be if Diesel-driven instead of oil-burning steam propelled) would not American ships be able to compete against Japanese and Chinese craft? Will Mr. Grosscup please reply?

MR. CHAS. B. BUSHNELL'S ADDRESS WANTED

Will Mr. Bushnell, of San Francisco, kindly send us his present address, as Post Office at that city advises us that he has moved and left no new address.

NEW MARINE OIL-ENGINE BOOK

We have received about 20 copies of Martin's book on marine oil-engines. Copies may be obtained from us, price $2.50 each including postage.

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Interesting News and Notes from Everywhere

BETHLEHEM COMPANY'S MOTORSHIP

We understand that the motorship now being built by the Bethlehem Shipbuilding Company has been named "Hagood." This has not been confirmed.

SEND CATALOGUES PLEASE

We suggest that American manufacturers of surface-ignition oil-engines of moderate power send their catalogues to Messrs. B. R. Herman & Co., boat-builders, Karachi, India.

DANISH COASTWISE MOTORSHIP "ROSEN"

A 150 h. p. four-cycle Holeby-Diesel engine is installed in the 600 tons coastwise motorship "Rosen," owned by the Dragor Shipping Company of Copenhagen, and built by the Codan Shipbuilding Company of Koge Harbor, Denmark.

ELEVEN MOTORSHIPS BUILDING FOR THE THORENSEN LINE

The Otto & Thorensen Linje A/S of Christiania have 23 ships aggregating 85,000 tons now under construction. Of these 11 will be motorships, and Burmeister & Wain and Werkspoor Diesel engines will be installed.

SWEDISH SUBSIDIES TO SHIPOWNERS

Although nineteen Swedish shipowners recently applied to the State for subsidies, only three have received awards. The Saltviks Slip, Oskarshamm, requested a subsidy of $40,000 to assist in the construction of two 400 tons d.w. wooden motor-auxiliary vessels.

ANOTHER 9,400 TON D.W.C. MOTORSHIP LAUNCHED BY THE GOTAVERKEN

The motorship "Elmaren" of 9,400 tons d.w.c. has been launched for the Rederi Transatlantic of Gothenburg, by the Gotaverken. She is a sister ship to the motor-vessels "Bullaren" and "Tisnaren," and is of 4,000 i.h.p. and 13 knots loaded speed.

BINDERS FOR 1919 ISSUES

We have some very neat and strong binders for the 1919 copies of "Motorship," with the word "Motorship" on the cover in gold lettering. We will send you one for $2.00 including postage, or free with a three years' subscription. Your present subscription will be regarded as one of the three years' subscription.

WHY THE ANGLO-AMERICAN OIL CO., LTD., RECENTLY ORDERED TWO LARGE DIESEL TANKERS.

Mr. James Hamilton, Vice-Chairman of the Anglo-American Oil Co., Ltd., a subsidiary of the Standard Oil Co., regards the Diesel-engine as a departure perhaps more far-reaching in its ultimate effects than the mere conversion of steam-driven vessels from coal to oil. In the development of the Diesel engine for marine purposes, he considers we have a great economic change.

SPECIAL TYPES OF RIVER VESSELS

We understand that two motor-vessels of a special shallow-draught type for river service are now under construction at Norfolk, Va., for service between Elizabeth City and Norfolk. These vessels are each of 200 tons d.w. and have a length of 120 feet by 32 feet breadth. The loaded draught will be 5 feet and the light draught 1 foot. In each vessel a Bolinder oil-engine will be installed. We understand that the same firm proposes to construct four smaller boats in each of which 150 b.h.p. Venn Severin oil-engines will be installed.

FISHERIES REVOLUTIONIZED BY MOTOR VESSELS—OVER EIGHT THOUSAND NORWEGIAN MOTOR FISHING-BOATS

(From U. S. Commerce reports, Dec. 9th, 1919.)

In 1915, out of a total population of 2,500,000 persons, Norway had 88,298 persons registered as fishermen, and 58,711 of them belonged to this district. In later years, especially during the last decade, an interesting evolution has been in progress in the fishing industry of this district, largely due to American petroleum. With the introduction of the petroleum motor-vessels the boats became larger, the range of operations more extended and continuous. From 1908 to 1915 the number of motor fishing vessels in Norway increased from 1636 to 8346, while in the same period the number of sailing vessels engaged in Norwegian fisheries diminished from 3861 to 1228.

CAMMELL-LAIRD-FULLAGAR ENGINES.

Several leading Liverpool shipowning companies have placed orders with Cammell-Laird of Birkenhead for ships to be fitted with the Fullagar-type of opposed-piston Diesel engines.

BOOK ON TRANSMISSION GEARS

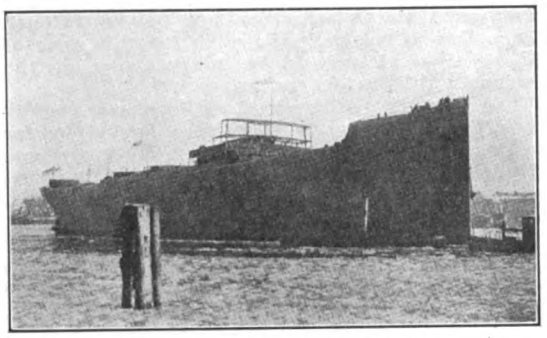
We have a few copies left of "Transmission Gears" by Edward Butler, M. I. Mech. E. This is a very excellent book. Obtainable from "Motorship," Wilson Building, 1270 Broadway, New York, price $3.00 including postage.

GERMAN SUBMARINE MINE LAYERS

Germany's largest submarine mine-layers were of 1,501 tons and 1,173 tons submerged and surface displacements, respectively, and were propelled by twin 1,200 shaft h.p. Augsburg-type Diesel engines. Length 266 ft. by 24 ft. breadth. Speed 14¾ knots.

OWNERSHIP OF THE TRAWLER "MARINER"

In our article on the Diesel-engined trawler "Mariner" published in the December issue of "Motorship," is was stated that this vessel is owned by Mr. Fred L. Davis of Gloucester. However, we have been advised that she is owned by the Marine Trawling Company of Gloucester, which is a stock company. The president of this company is Mr. Fred E. Morris.



Launch of the 13-knot, 9400-tons d.w.c. motorship "Elmaren" at the Götaverken for the Rederi Transatlantic. She is a sister ship to the "Bullaren" and the "Tismaren," and all have B. & W. type Diesel engines of 4000 I.H.P.

AUXILIARY MACHINERY OF NEW MOTOR TANKERS.

In the January issue of "Motorship," we referred to the two motor tankers for the Anglo-American Oil Co., on order with Vickers, Ltd. In contrast with the Tanker "Santa Margherita," also built by Vickers, the cargo machinery of the new ships wil be steam driven, whereas the first named vessel has Diesel-electric equipment. On the tank deck aft, abreast the machinery space, are the fuel bunkers. The main cargo space consists of ten tanks divided into pairs by a longitudinal centerline bulkhead. The remaining space forward of the cargo tanks is sub-divided into oil-fuel or water-ballast tanks and cargo hold. The 'tween deck spaces over the oil tanks at the sides of the expansion trunk are arranged as summer tanks for cargo oil. There are two sets of cargo pumps, of horizontal duplex type, steam-driven, each capable of pumping 200 tons of oil per hour under normal working conditions.

Oil is drawn from the tanks through two lines of piping and delivered into a deck line of piping. Branches are fitted on the deck line of piping, so that the oil may be discharged over either side. Accommodation is provided for the officers in a large deckhouse amidships, the crew being berthed under the forecastle. The engineers are accommodated under the poop, where there are also a commodious workshop and stores. The vessel's auxiliaries are all operated by steam, except one of the two dynamos, which is coupled to a Petter surface-ignition oil-engine, and the forward windlass is arranged to handle 2 5/16in. cable. The steering gear is of the William-Janney electro-hydraulic pattern, with telemotor control. There are three winches of double cylinder horizontal type, one 7in. by 10in. on the upper deck forward, one 7in. by 10in. on the upper deck aft, and one 8in. 12in. on the poop deck, all having extended ends. The main propelling machinery is installed aft.

OIL-FUEL BUNKERING STATIONS

The various leading oil companies have between them nearly 300 oil-fuel bunkering stations at about 150 ports in different parts of the world, and another 30 stations are under erection.

MOTOR CRAFT AT STAVANGER AND HAUGESUND

At the end of 1918 there were 75 commercial motor-craft of 4,434 gross tons at the Norwegian port of Haugesund, while at Stavanger there were 38 motor-vessels of 1,883 gross tons.

CONVERTING THE "DORA SEWARD"

The old British-Columbian schooner "Dora Seward" is to be converted to a motorship by Mr. A. Bechtel, who will then place her on the market. The hull, which will carry from 250 to 350 tons of cargo, will be fitted up for the coal, or ore trade, and a crude-oil engine of 125 h. p. will be installed as propelling power.

"VALDIERI" IS NAME OF TOSI MOTORSHIP

On page 121 of our February issue we published plans of a large Tosi Diesel-engined cargo ship. This vessel is the "Valdieri," of 8,000 tons d.w.c. and 2,200 s.h.p., which is building to the order of the Cantiero Nav. Franco Tosi Taranto, of Legnano, Italy. Motorships of similar designs are under construction in Scotland at the yard of Messrs. William Beardmore & Co., Dalmuir.

AND NO HULLS ARE AVAILABLE FOR THE DIESEL ENGINES NOW BUILDING.

Some time ago the United States Shipping Board contemplated reinstating orders on three suspended steel ships at the yard of the Hanlon Dry Dock & Shipbuilding Company, Oakland, Cal., with a view tc installing a pair of Diesel engines in each vessel. However, the Board definitely canceled the contract for these vessels, so there is no likelihood of the engines being installed, altho' they are now under construction.

CARGO CAPACITY OF THE MOTORSHIP "ASIA"

The new Danish motorship "Asia" has a cargo capacity (hold) of 560,000 cubic feet of grain, or 525,000 cubic feet of bales when carrying sufficient fuel for a voyage of 33,000 nautical miles at 11½ knots. In order that shipowners may compare this capacity with the capacity of oil-fired steamers of similar size, we give the dimensions of the "Asia."

Length, O. A.	442 ft. 6 in.
Length, B. P.	425 ft. 6 in.
Breadth, M.	55 ft. 0 in.
Depth, M. to shelter deck	38 ft. 6 in.
Depth, M. to upper deck	30 ft. 6 in.
Speed of ship fully loaded	11½ knots
Power	3,100 I.H.P. at 125 R.P.M.
Daily fuel consumption	10.4 tons
Fuel consumption, including auxiliaries,	0.306 lb. per I.H.P. hour, or 0.397 lb. per shaft H.P. hour
Engine-room staff	13

Her dead-weight capacity on 29 ft. 1 in. draught is 10,800 tons. Of this, 1,232 tons in fuel-oil; but, as 565 tons of oil is sufficient to carry her about 11,250 nautical miles, it means that on most voyages she will be able to discharge at least 650 tons of oil-fuel as cargo.

This means that her actual income-earning cargo-carrying capacity is about 9500 tons after allowing for drinking-water and stores, whether carrying light, bulky freight, or heavy compact cargo. In other words, the motorship has the steamship beaten both coming and going.

Because, when carrying cotton or similar cargo from America, she can carry a full load of fuel-oil in her double-bottoms and sell over 50 per cent of this fuel as cargo in Europe. Or, when shipping heavy cargo, such as iron-ore or machinery, she can run with some of her fuel-tanks empty, and fill her roomy holds with freight. In other words, she can practically always get her load of 9,500 **net** tons of cargo on voyages of moderate length. On a 30 ft. 6in. draught her d.w.c. is 9,500 tons, but it will be realized from the foregoing that with a motorship the term d.w.c. is most misleading, as sometimes the d.w.c. represents almost all cargo, whereas with a steamer about 1,500 to 2,000 tons has to be deducted for fuel, boiler-water and stores, according to the length of voyage, before the actual cargo-capacity is arrived at.

The "Asia" and many other motorships were built and engined by Burmeister & Wain for the East Asiatic Company during the period that many of our shipbuilders and shipowners were asleep.

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